WORK

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WORK WORLD.

OVER 150,000 Safety bicycles were made in Great Britain during 1891, and it is computed that there are more than three-quarters of a million cyclists at present in the United Kingdom. This is at least a third more than in 1890, so much has the present form of cycle taken with the public.

* *

Dynamite in Cornwall is not in an unsuitable quarter. This will account for the factory which has been recently started at Perran for the manufacture of dynamite. "It's an ill wind"—and a neighbouring saw-mill will benefit, as the proprietor has an order from the company for 2,000 boxes in which to pack the dynamite.

* *

The Liverpool authorities are not keen on electric lighting for their city. The Council have decided not at present to adopt it. The cost for lighting the business portion of the city would be about £9,800 per annum, as against £3,800 for gas. Nevertheless, a number of business premises and private houses are lighted by electricity supplied by a local company.

* *

An egg, measuring 8½ in. in girth the long way, 6½ in. in girth the other way, and 3½ in. long from end to end, and weighing 4 ozs., was produced recently by a barndoor hen at the smithy croft of Roslinfield, Kincardine. A quarter pound of egg in one shell! This should induce dissatisfied capitalists to "catch on" at egg and poultry culture.

* *

The latest samples of timber imported into England by a Pahang Company comprise mahogany, teak, rosewood, oak, ebony, cedar, walnut, and satinwood. The wood comes from Pahang, about forty miles from Singapore, and is floated or carried down by the steamers to the mouth of the River Pahang, and carried thence by steamers to Singapore, and shipped from there to England. The estates comprise about eleven million acres, or about 10,000 miles, and are mostly wooded. As the supply of teak is reported to be limited, this importation from Pahang will be of great assistance to the trade. The wood is very easy to work, but is, in some cases, heavy. The Company has shipped here about 2,180 loads of a London market value of upwards of £18,700, in addition to the local sales.

* *

A Newcastle firm of iron merchants have hit upon something of a new idea. In buying up scrap steel and iron they often come upon large forgings that require to be broken up before they can be made marketable again. To break them up, as a general rule, holes some 2 ft. deep are drilled by hand, and filled with dynamite cartridges, the forgings then being blown to pieces. The firm in question, having lately come into possession of several hundreds of tons of large steel forgings, the engineer resolved to get out a multiple drilling machine with six or more drills to operate at one time together, with the necessary plant for works where large forgings, etc., could be broken up. This has proved a success.

* *

It appears that the local steeple-jack is to be entrusted to erect a temporary chimney to take the place of the one which fell with such disastrous results at Cleckheaton, near Bradford, a few weeks ago. From all accounts, the job could not have been put in better hands, this "jack" having had great experience for many miles round. "I do not think there is a man in England," writes our correspondent, "who is more at home than he is on the top of a chimney from eighty to a hundred yards high, and the few accidents he has experienced during his career testify to his ability as well as to his care in the selection of material and scaffolding." *Terra firma* folks will not be enviable of such a reputation—the maintenance of which, in the present instance, will, no doubt, occupy the attention of the Government inspectors.

* *

At the recent meeting of the Birmingham Technical Schools Committee, a return was made showing a membership roll of 1,187 students. The bronzing and electro-plating class had proved very successful, but, strange to say, it is resolved to advertise for a competent teacher for this class; and as the subject was one that has hitherto received little study in this country, it has been suggested to go to France or Germany for a teacher. Such a proceeding is scarcely creditable to the metropolis of the Midlands, when its jewellers and silversmiths can easily set London an example in the matter of technical instruction. A town which can claim the home and works of such famous electro-platers and silversmiths as the Elkingtons, ought to look elsewhere than a foreign country for its technical tutors and professors. Where are the South Kensington authorities, and what are they about?

* *

A new cold galvanising process has been introduced. It is stated to be superior to the old plan of hot galvanising, which has many defects, the chief of which are—waste of zinc, reduction of strength in small wires, and a tendency to make small section iron and steel brittle. By this system the coating affords a better protection than an equal thickness put on by the hot process, and the coating is much more adhesive. That the galvanising put on by the old system was, and is, very faulty in this respect, is well known by all who have had to work galvanised sheet iron or steel, and any improvement in this respect will be of great utility. It is also claimed for the process that fine mesh wire, small screws, and so on, can be coated without clogging up, and the coat is said not to exceed that of the old system.

* *

A square hole drilling machine is being more and more perfected. Now a great variety of holes can be drilled with the utmost accuracy with the same cutter, or drill. The machine resembles an ordinary hollow-frame drilling machine, being arranged on a massive frame, giving the necessary stability to stand the side strains of angular drilling. The essential difference is, that whereas an ordinary drilling spindle revolves on its own fixed axis only, in the machine in question there is a side or lateral play of the point of the drill, regulated by the guide templates provided at the top of the spindle, the spindle being held about half-way up its length by a ball socket bearing. It will drill holes of almost any shape: regular, angular, or irregular, and semi-circular; and also drills round holes, without alteration, by the simple adjustment of a screw. For our information an hexagonal hole was drilled about ¼ in. deep in a piece of brass, and inside this a square hole with its angles just touching the sides of the hexagon, and inside the square hole a round hole just touching the sides of the square, each sinking being about ¼ in. deep, and to the greatest nicety.

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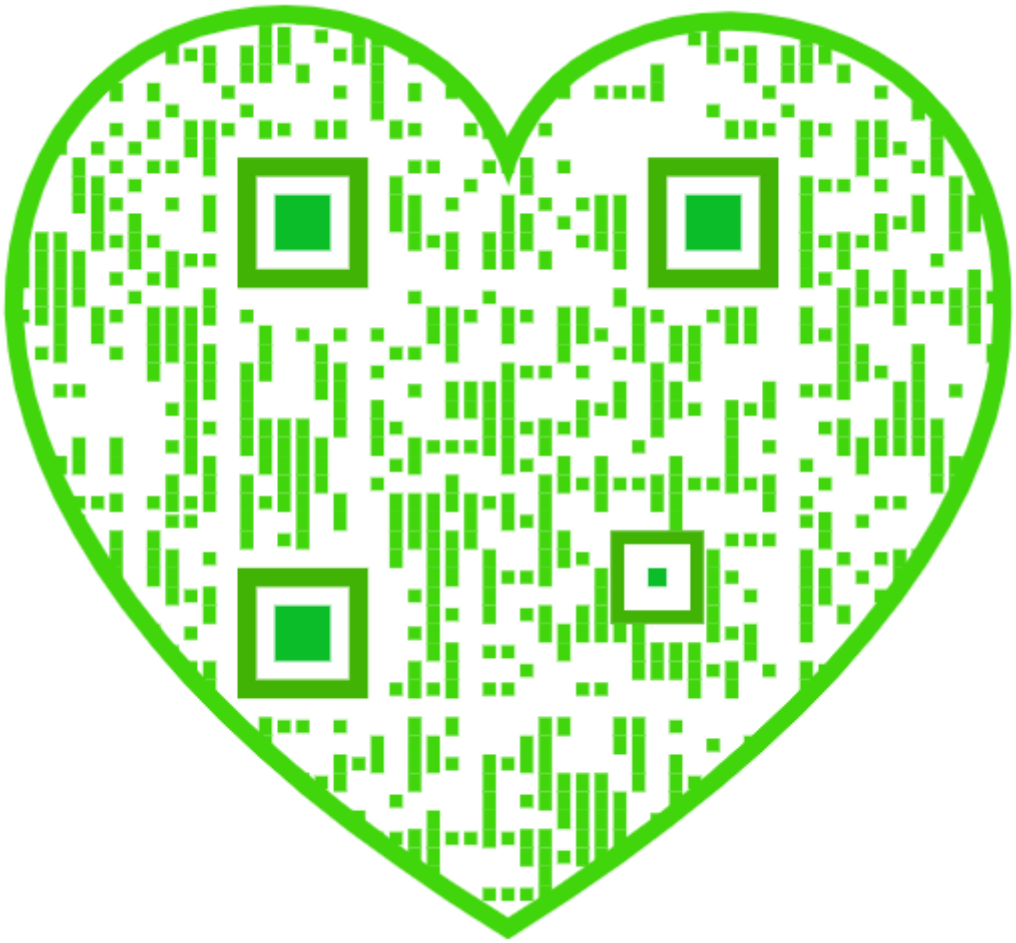


The latest application of the Slide Rule is to the calculation of the discharge of water pipes, including these three problems: (1) Given head, and length, and diameter of pipe, to find the discharge; (2) given discharge, head, and length, to find diameter; (3) given length, diameter, and discharge, to find head.

* *

Those who see in the nationalisation of existing industries the Ideal of Labour would doubtless ponder over these figures. In 1870 Government acquired the telegraph system of the country at a cost of rather over £10,000,000. It has worked that system for twenty years, and has lost £4,000,000 by the transaction. Only in the first two years has there been any surplus; ever since there has been an annual heavy loss.

* *

Work on the Manchester Ship Canal is being pushed on vigorously, particularly the construction of the iron viaducts and bridges. The swing bridge at the Salford Docks is well in hand; it is the heaviest of its kind in England, containing eighteen hundred tons of steel and iron. The remarkable swing aqueduct which is to carry the Bridgewater Canal over the Ship Canal at Barton is also well advanced.

* *

The electric-lighting arrangements at Lambton Castle, the seat of the Earl of Durham, have just been reorganised. Two new engines of the latest type steam turbines have just been fixed, and are coupled direct to the dynamo, and their combined power is 100 horse. The dynamo runs at a speed of from 4,000 to 5,000 revolutions per minute, the flow of steam being in a radial direction, instead of being parallel to the axis, as in the old form of Parson's machines. Each is fitted with a novel and special governor, designed to maintain a constant electrical pressure at all loads. The governors are electrical in action, and work by admitting the steam in puffs of longer or shorter duration, as required for the load, producing an equivalent of alternate expansion, which greatly increases the economy of the engines when running below full load. A fly-wheel is also fitted, which prevents the intermittent action of the steam from causing a fluctuation in the lights. Steam is supplied by two Cornish boilers at a pressure of 100 pounds per square inch; and a battery of accumulators capable of supplying 220 lights for nine hours is fixed. Many new fittings have been added, and the total number of lamps is about 600. The installation is now amongst the most extensive private electric light plants in the country.

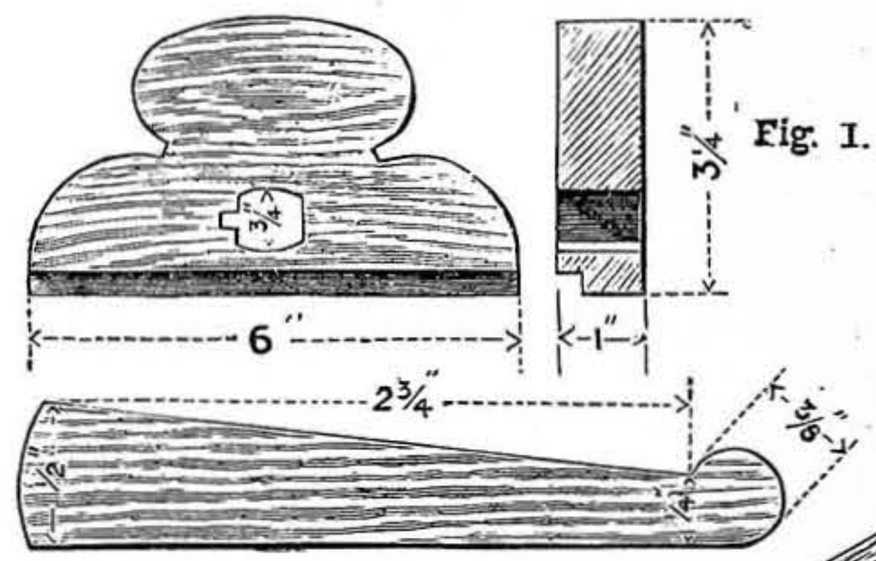
THE WAY TO MAKE A PANEL GAUGE.

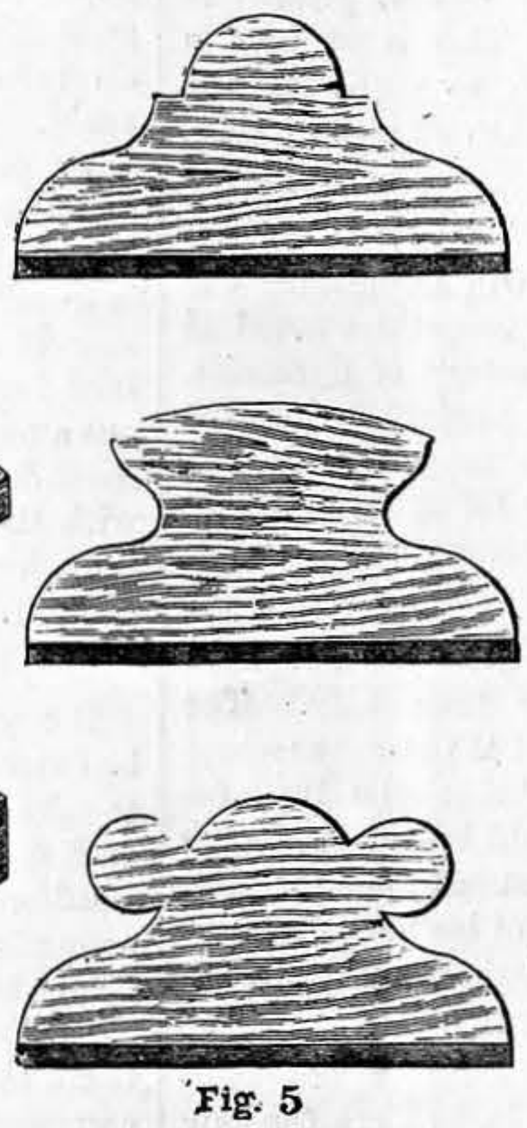
BY F. CROCKER.

THE STOCK—THE WEDGE—THE STEM.

IN WORK, No. 142, a correspondent asks to be supplied with a drawing of a panel gauge, and as this is a tool that may be useful to a good many of our readers who do not possess one, a short paper is here devoted to the construction of one.

A panel gauge is used to mark a line parallel to the true edge of a panel, or any piece of wood that would be too wide for the ordinary gauge to take in.





Panel Gauge. Fig. 1.—The Stock. Fig. 2.—The Wedge. Fig. 3.—The Stem. Fig. 4.—The Panel Gauge. Fig. 5.—Patterns for the Stock.

The *Stock* is shown in Fig. 1, drawn to a scale of 3 in. to 1 ft. This is made of maple, beech, or any other suitable wood. As may be seen by the drawing, it is 1 in. thick, and has a ⅜ in. by ⅜ in. rebate at the bottom. A mortise is made for the stem to pass through, and another one at the side for the wedge. The first may be cleaned out with an inside ground gouge, and is ⅜ in. wide. The bottom of the mortise is a full ¼ in. above the rebate. The edge is shown square, but it is an improvement to have it rounded.

The *Wedge* is shown in Fig. 2. It should be made of box-wood or ebony if possible, and is a bare ¼ in. thick. The other dimensions may be gathered from the drawing. The taper of the mortise in the stock must be made to correspond with it.

The *Stem* (Fig. 3) should be about 2 ft. 6 in. long, and may be made of a piece of straight-grained mahogany. It should fit the mortise, not too tightly, but so that it can be moved with the hands without tapping, and is held in position by the wedge when set. A piece is dovetailed in the end, as shown, to bring the marking point level with the bottom of the rebate. The stem may be made square if preferred or if the rounded mortise presents a difficulty.

Fig. 4 is a sketch of the gauge when finished, and in Fig. 5 three other patterns are given for the stock, but which is the nicest shape is purely a matter of opinion; either will give satisfaction if well finished and nicely polished.

HOW TO WORK CORK PICTURE FRAMES.

BY ARTHUR YORKE.

CORK FRAMES—THE MATERIAL—TOOLS—CUTTING OUT—THE WOODEN FOUNDATIONS—FASTENING ON—FINISHING—DESCRIPTION OF THE DESIGNS.

Cork Frames.—The devices of ingenious amateurs for framing pictures ornamentally without going to the cost of regular professionally made frames have been many in number, and the range of materials pressed into the service has been a wide one. One of these ingenious makeshifts is the cork frame. It has decided points in its favour. The material costs little or nothing. Expensive tools and appliances, like those needed for wood carving or leather work, can be dispensed with; far less skill is required than in those arts; yet much of the richness of effect gained by them may be attained through it. Patience is, perhaps, the first quality essential to the successful cork worker. His work will not have the sterling qualities of wood carving, but it will look and be more solid than leather work; and, as is shown by the designs before us, scraps of the material, cut to a few and simple shapes, may be so combined as to give an unlimited variety of pleasing patterns.

The *material* is too well known to need much comment. Cork, as we are most of us aware, is the outer bark of the *Quercus suber*, a kind of oak which grows in Spain and Portugal. Its uses in the arts are numberless. The form in which we are most familiar with it is that to which it is cut as bottle-stoppers; and if our intending cork worker proposes to go upon the most economical lines, he will probably content himself with disused bottle corks. In the designs given there is nothing that cannot be carried out with such very humble materials. The difficulty which rises from working with old corks is that they are often sadly damaged by the screw.

It may, however, be supposed that anyone intending to work with used corks will not only have them saved in his own house, but will ask his friends to save for him likewise; and if he does this he will soon have such a store on his hands that he may well afford to throw aside all unsuitable ones. It may be hinted that all sorts and sizes should be saved, the small ones from

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phials, etc., often coming in useful as well as the larger ones.

Or, if he indulges in the luxury of new cork, he will not find it costly. In this case he will choose such as has a close, firm grain. In the shape of bottle corks those sold as "wine corks" are the best. But a cork cutter will provide him with the material in many other forms. It is to be bought in sheets of regular thickness, and these, if elaborate work is engaged in, may be found useful. Some sheets, for the use of hatters and others, are cut as thin as paper; others, for shoemakers, naturalists, etc., of greater thickness. There are purposes, to be more fully spoken of hereafter, for which sheet cork may be found handy.

Tools.—This section of the subject might be made almost as concise as the famous chapter on Irish Snakes. Tools are not needed, except that tool which everybody has in his pocket—namely, a knife. The knife for cork cutting should be thin, and kept exceedingly sharp. To make that good, clean cut which is essential, it should be used with a drawing motion, somewhat as a razor in shaving, and not with a direct downward action.

Cutting out.—In the designs given it will be seen that most of the pieces employed in forming the patterns are made by cutting the ordinary bottle cork into transverse sections. To produce good work it is essential that the pieces to each given pattern should be of equal thickness. Practice will soon accustom a person to cut them with regularity, but till that knack has been acquired it will be well to have a gauge, made of card, or better, of sheet metal, with which to test them before using—all that do not agree with it being laid aside for other purposes.

The Wooden Foundation.—This is generally made of deal, and as it is scarcely, if at all, seen in the finished article, no great neatness is necessary. An indifferent amateur carpenter can make it sufficiently well. The foundation or actual frame is shown in the different sections. There are various ways of dealing with those parts of the foundation not hidden by the pattern, as will be explained in due course. Or, instead of

Fig. 4.

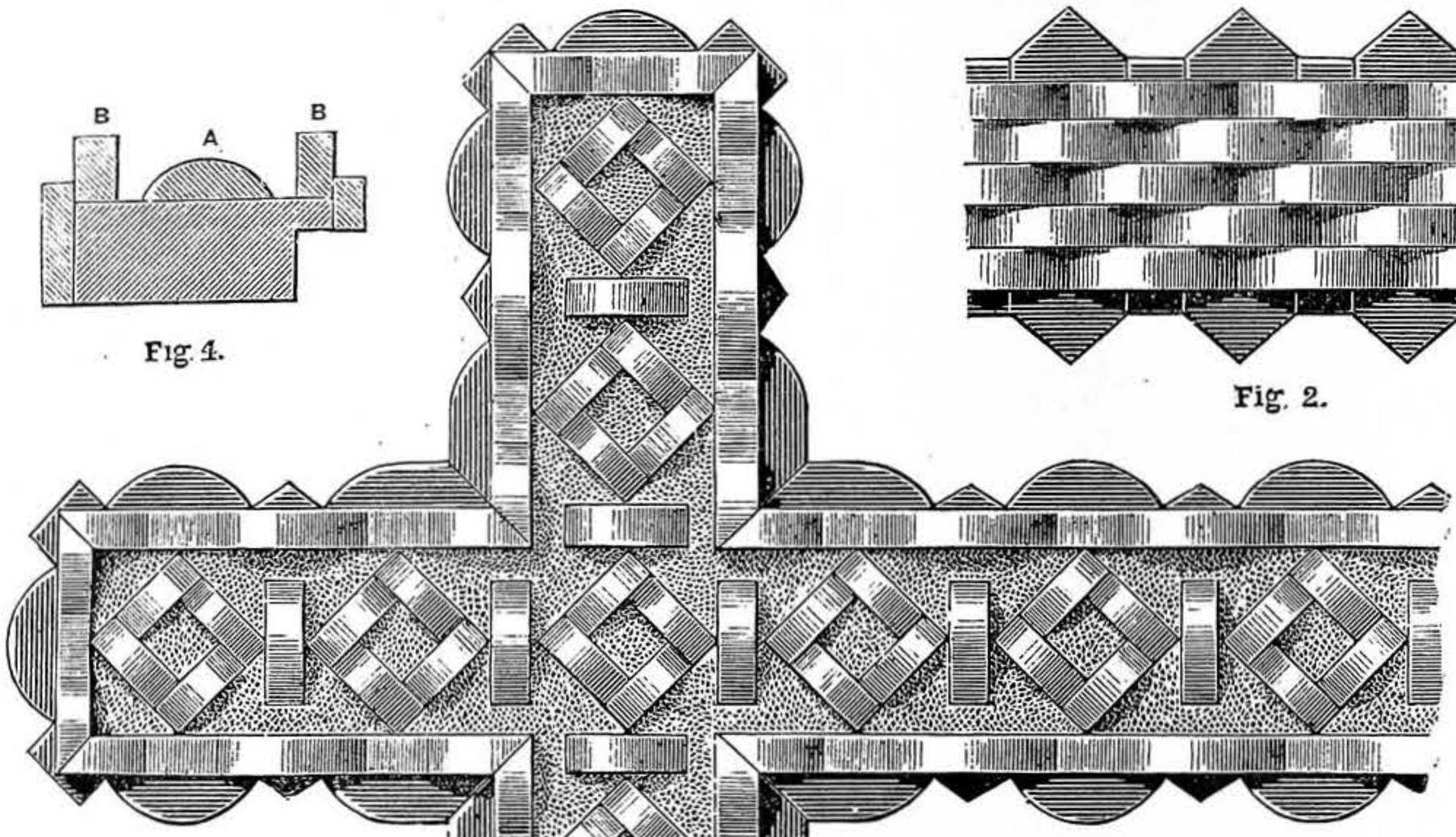

Fig 1.

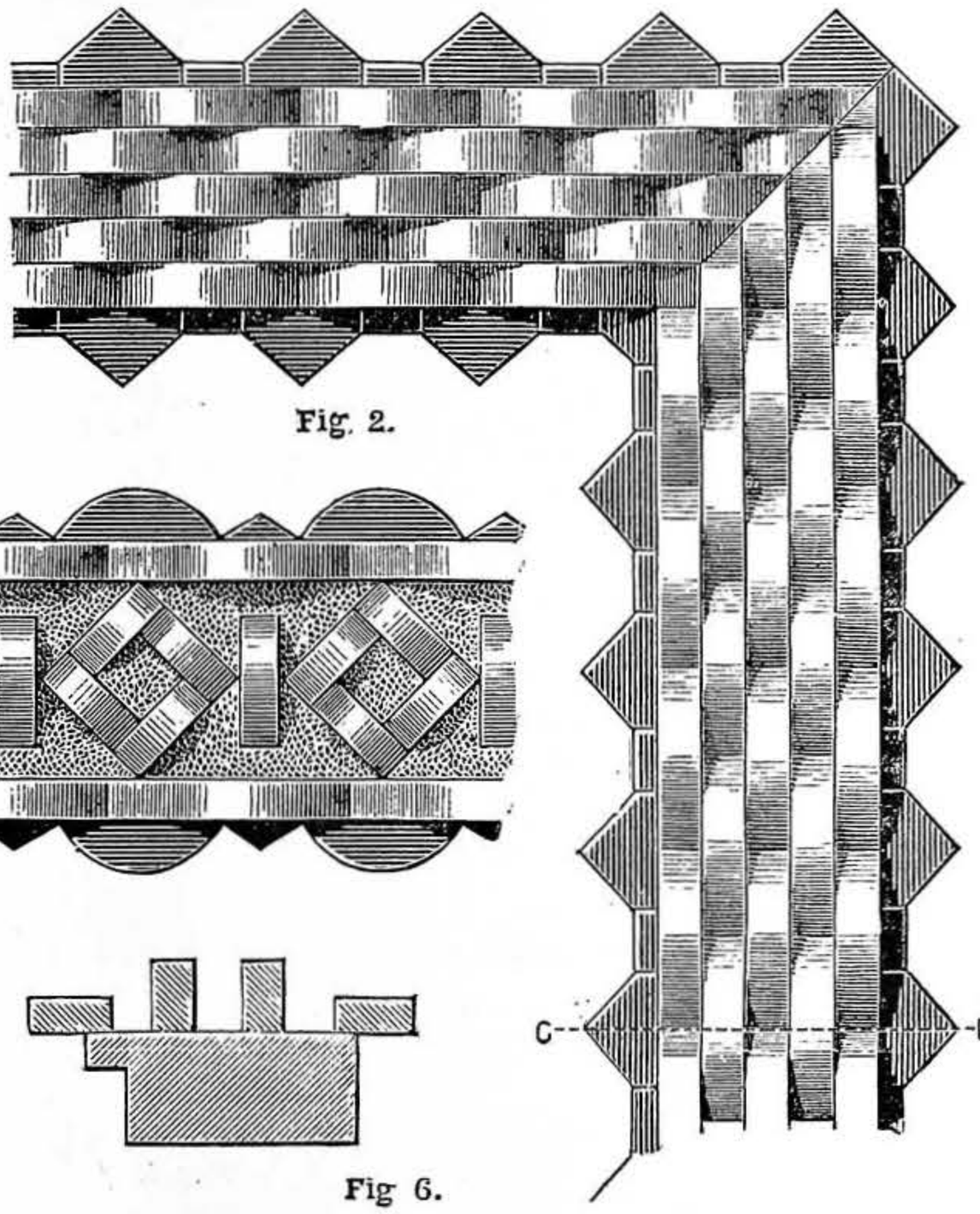

Fig. 2.

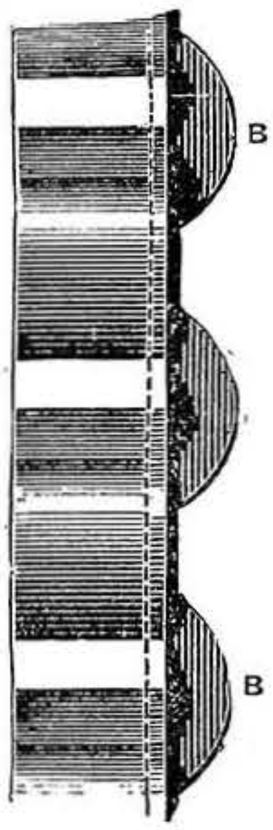

Fig 5.

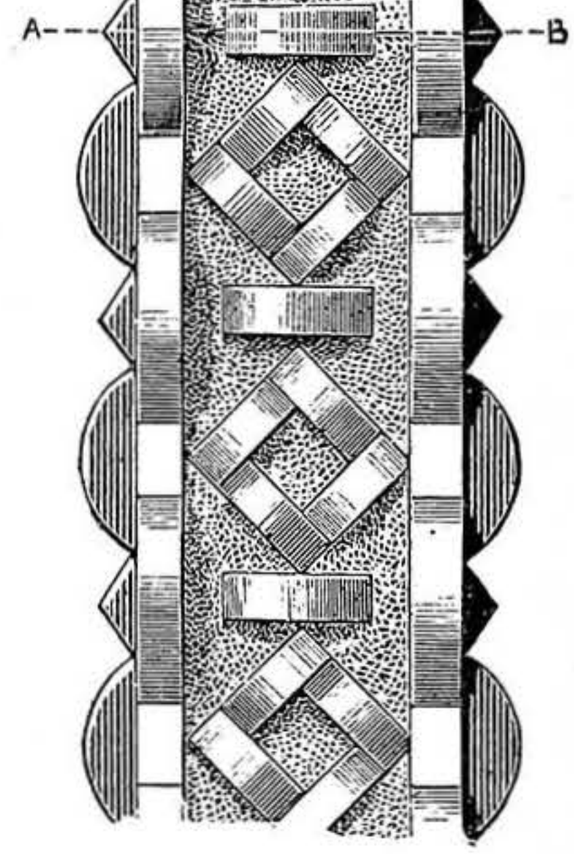

Fig 6.

Fig. 7

Fig. 8.

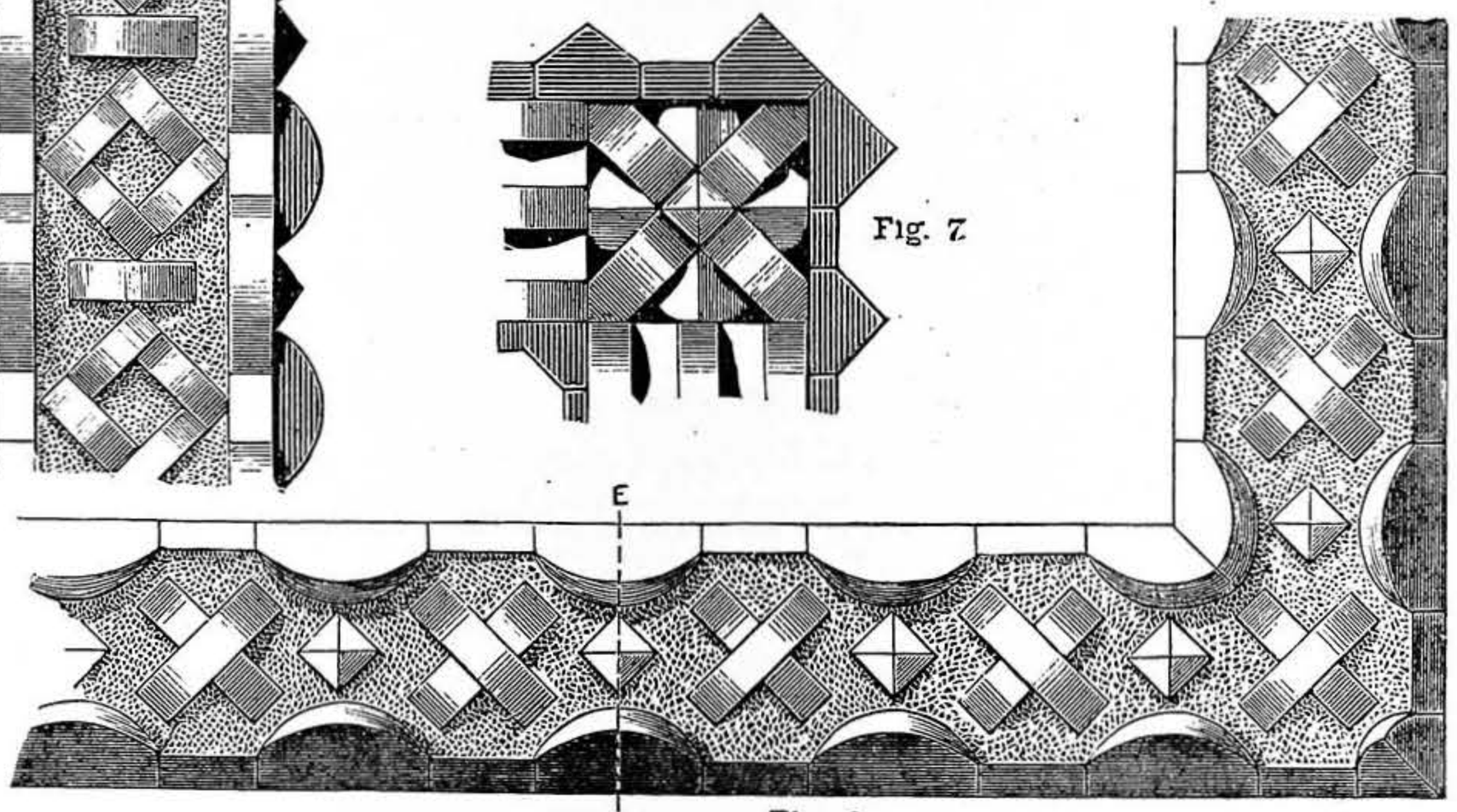

Fig. 3.

Cork Picture Frames. Figs. 1, 2, 3.—Designs for Cork Frames. Fig. 4.—Section of Fig. 1 on Line A B. Fig. 5.—Elevation of Side of Fig. 1. Fig. 6.—Section of Fig. 2 on Line C D. Fig. 7.—Alternative Corner for Fig. 2. Fig. 8.—Section of Fig. 3 on Line E F.

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deal, the foundation may be made of some wood which, like teak or cedar, will match the cork in colour, and which may be left as it is.

Fastening on.—The pattern being arranged, and the pieces of cork ready, the latter have simply to be glued to the foundation. The glue should be moderately thin, but strong. In these days, when Le Page's and other excellent liquid glues are in the market, it is scarcely likely that the cork worker will resort to the orthodox glue-pot; indeed, to those who follow this art, liquid glue is an especial boon.

Finishing.—To do this a couple of coats of varnish should be given. Coachmakers' body varnish is that usually employed.

Description of the Designs.—It will be seen that in Fig. 1 the Oxford form of frame has been given; the simple pattern upon it might, however, as well be placed on a frame of the simpler shape. In the section of it (Fig. 4), the form of the slices of bottle cork which make the ornaments of its centre may be seen at A. The alternate pieces of the projecting border, B B (Fig. 5), are much the same, but a trifle larger; these last also appear in section at B B (Fig. 4). It will be seen from the elevation (Fig. 5) that the sides of this frame are entirely covered and hidden by pieces of cork, which are not only glued to the sides, but also to the lower parts of the pieces which form the projecting border. These pieces, with alternate curved and triangular outlines, show their upper ends in Fig. 1.

The projecting ornament in Fig. 2, though of a kind which does not appear to advantage on paper, is highly effective when actually worked out in relief, recalling some of the beautiful ornament of high-class turning. It is, as will be seen, simplicity itself. The pieces forming it are all similar, and in shape like A (Fig. 4).

To make this pattern look well, however, requires that there should be exactitude in the size of the pieces and in sticking on. It will be observed that in this design the flat border is not formed, as in the last, by pieces glued to the sides, but by thin pieces glued to the face of the foundation. Thus the sides of the frame are not covered as in Fig. 1. The section (Fig. 6) illustrates this. Fig. 7 is an alternative corner for this frame. If preferred, it can be used in any case, but it has been introduced with a view to the possible employment of this pattern on an Oxford frame, when the original pattern could not well be continued through the intersections. A square of cork, from $\frac{1}{16}$ in. to $\frac{1}{8}$ in. thick, should first be glued over the corner, and the flower built up upon it, so that a little more projection may be gained than in the other work.

The frame (Fig. 3) is, owing to the sloping form of the border, rather more difficult, but with a card gauge of the exact angle the novice may cut the pieces accurately.

I shall have something further to say on this subject, but my remaining remarks must be reserved for my second and concluding sheet of designs. Meanwhile, my readers will find much to occupy their patience, taste, and ingenuity in the ideas already set before them. In view of the coming bright days, the subject of cork frame making is one which will be found to offer a particularly pleasing pastime.

HOW I HEATED MY GREENHOUSE.

BY SAINT MUNGO.

HAVING erected a small greenhouse in the spring of last year, when the cold weather came with the autumn I began to think of putting in some kind of heating apparatus to preserve my plants during winter, and bring forward seeds and cuttings in spring. After consulting catalogues and price-lists innumerable, I came to the conclusion that I could not afford to get hot water fitted up in the regular way. Gas was out of the question, and the disastrous nature of a friend's experience with paraffin warned me to steer clear of it, as it proved to be neither cheap nor efficient. I next thought of a flue, and found that some neighbours succeeded fairly well with flues, but all advised me against them and in favour of hot water. So to it I turned my attention again, and, after examining one or two different methods, set about the construction of a heating apparatus which has proved both cheap and efficient, and which I shall proceed to describe.

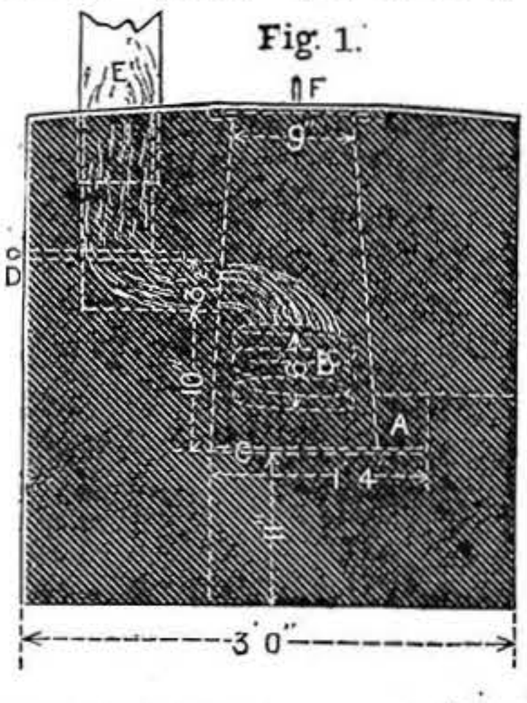
My first proceeding was to consider how much piping, and of what diameter, it would take to keep up the desired temperature. My greenhouse measures 12 ft. by 8 ft., and is 6 ft. high at the eave, with a shed roof, and the door is in the middle of the front, which is also the 6 ft. side; so I decided to run the pipes along the back and one end, putting the furnace outside, as shown on the ground-plan. My intention was not to be able to keep stove plants, but simply to preserve my plants during frost and to dry the air during spells of cold, damp weather, and I find that this length and disposition of pipes is ample for my purpose. If more heat were required, I would add pipes along the other end, and put the stove at the front corner. There are pipes specially made for hot water, but I found that rain-water pipes were cheaper, and with care would do equally as well; so, through my plumber, I procured four 6 ft. lengths, and two 3 ft. lengths of 4 in. rain-water pipes, and four corner bends to suit, for all of which I paid 15s. 2d. The reason for my getting four corner bends will be obvious on looking at the illustrations, as single return bends are not made to suit rain-water pipes, hence I had to use two corner bends, as shown at Fig. 4. As rain pipes are made much thinner than hot-water pipes, and flaws are by no means rare, I was careful in selecting mine to see that they were sound.

I was fortunate in my selection, and have had no trouble from this cause. My next step was to get a maker of malleable iron tubing to make a coil (as shown at Figs. 1 and 2). The distance between centres of the 4 in. pipes when connected I found would be 12½ in., but, as I did not wish my coil to be so deep, I had it made as shown in the sketch, which also gives the sizes and the correct number of turns. This coil, made of 1¼ in. (outside diameter) pipe and screwed to fit the plugs presently to be mentioned, cost me 12s.

The plugs were simply pieces of cast iron made to fit the ends of the 4 in. pipes, one to fit inside of the faucet, and the other to fit inside of the narrow end, each being about 4 in. long, and fitting slackly enough to allow for packing the joint. They were screwed to fit the ends of the coil, and cost sixpence each. Before commencing to join up the pipes I bored a ¼ in. hole at E in the upper side of the bottom pipe, and another at F in the top bend, and screwed them with a ¼ in. tap. The use of these holes will be explained presently.

A small stop-cock screwed into the bottom pipe at E is also a great convenience for obtaining a little hot water to temper the water for watering plants on a frosty day, or for running off the water should it be thought necessary. The distance between the centres being, as already stated, 12½ in., I cut out of ⅞ in. yellow pine six pieces, shown in sketch (Fig. 3). By means of hoop iron and wire nails I bound the pipes together in pairs into the hollows in the ends of these pieces (see Fig. 4), being careful to keep the ends reversed so that they would connect properly with the bends at the return end F.

Of the many ways of making joints I chose red lead, as it does not set too quickly, and when one cannot be working continuously that is a consideration; then it is more easily taken asunder if needed for removal than a rust joint or Portland cement, both of which are often used. I made the red lead into a stiffish paste with linseed oil, soaked pieces of teased rope in it, and rammed them tightly into the joints with an old table knife broken at the point. As I did not wish to disturb my staging and plants, I put the joints marked D, C, and A together outside where they were also more easily got at, then the pipes were put in position and temporarily supported on bricks when the joints at B were made; finally, the arms of the coil were inserted from the outside through holes cut in the wood lining, the plugs screwed on with a little red lead, and the remaining joints between them and the pipes made.



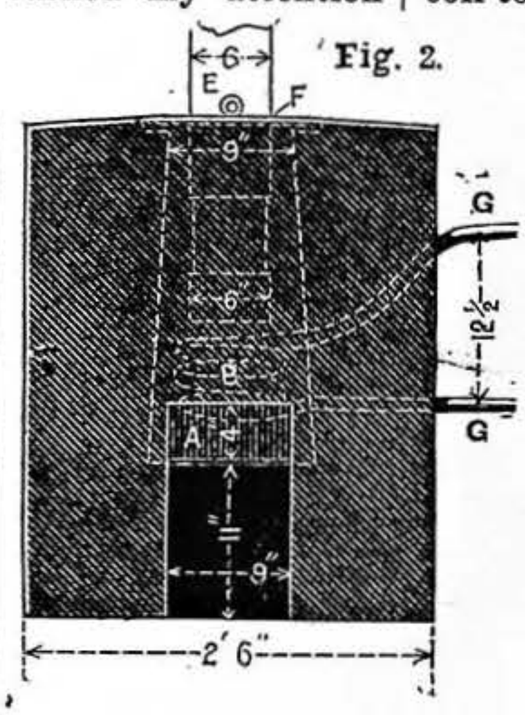


Fig. 3.

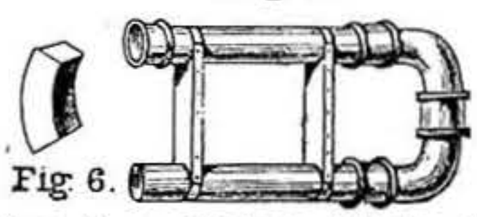
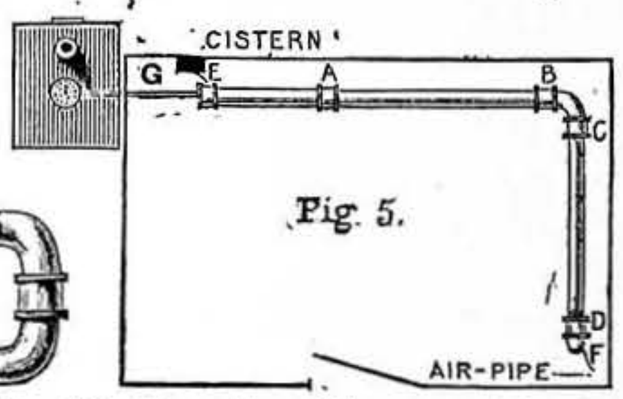


Fig. 4.

Fig. 6.



Greenhouse Heater. Fig. 1.—Side Elevation of Furnace. Fig. 2.—Front Elevation of Furnace (Figs. 1, 2)—A, Removable Firebrick closing Opening of Furnace; B, Coil of Iron Pipe; C, Grating at Bottom of Fire (Cast Iron); D, Damper in Chimney at Back; E, Chimney; F, Cast-Iron Lid of Furnace; G, Ends of Coil for connecting to Circulating Pipes. Fig. 3.—Pieces of Wood for connecting Pipes as shown at Fig. 4. Fig. 4.—Method of connecting and supporting Circulating Pipes. Fig. 5.—General Ground Plan of whole Apparatus. Fig. 6.—Shape of Firebricks used in building Furnace (called "Pups" in the trade).

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As they were as yet only temporarily placed as to level, although in proper position otherwise, I proceeded to give them the necessary slope. To secure this I planed a piece of wood with a slight taper on it; on placing this on the top of the pipes, with a level on the top of it, and packing up below the pipes with bricks and slates till the bubble was in the centre at any part, taking care to keep the thick end of the bevelled piece towards the coil, a gradual slope was obtained, making the end at F about 2 in. higher than that at G. This allows the water after being heated in the coil to ascend and promote a steady circulation.

Then I took an old meat tin, and to a hole in the middle of it soldered a piece of ¼ in. gaspipe, with a nipple soldered on the end of it, screwed to fit the hole already mentioned at E. At F I screwed in a similar nipple, with a short length of gaspipe, leaving the upper end open, and a little above the level of the tin can at E. E is the filler and reservoir, and if placed so that the surface of it is only a few inches above the top of the 4 in. pipe at its highest part it will do. The lower it is kept the better, as every inch added in height increases the pressure on the joints, which is quite as great communicated through a ¼ in. pipe as through a 2 in.

The pipe at F is an air pipe; without it the pipes would not let in the water at all. After giving the joints a few days to set I filled the pipes with water, and finding that they were all tight, proceeded to build the furnace round the coil. As it was my first attempt at brick-building, I did not manage to go straight ahead and get everything right at first, but had to feel my way cautiously, and eventually got it as I will describe. The sketch shows a cross and a longitudinal section on which the sizes are marked. It took about 150 bricks, and about 1 cwt. of lime. The centre immediately round the coil is built with the circular firebricks used for building brass-melting furnaces, adopted as shown at Fig. 6. It took six of them to go round the circle, and there are eight such circles. One brick is left loose at A (Figs. 1 and 2) for kindling and cleaning out ashes, and a flat piece of iron put in to support the bricks above the opening. There is just about 1 in. between the coil and brickwork all round, and towards the top the circle is gradually contracted. The reason for this is that if the sides were straight the coke would be apt to jam and allow the fire to burn out underneath it. The taper, although very slight, has the effect of making it drop down as the fire burns away beneath and keeping up a regular supply of fuel. The opening to the chimney goes out just clear of the coil, and the damper is put in from the back, as shown. The chimney consists of two lengths of 6 in. rain pipe, in all about 10 ft. long, and gives a splendid draught. To close the opening at the top of the furnace, I procured a cast-iron cover fitting into a checked ring which I fixed to the brick on the top, and after fitting a firebrick to close the opening at, I was ready to light the fire. The fuel I use is unriddled coke, which I get from the gasworks at about 4s. 6d. per ton including cartage, but dross would burn in it as well.

I generally keep a bag of nuts for kindling, as they light up quicker than coke. Closing the brick door in front, the fire is kindled inside from above, and after it is quite red it may be filled right up to the top with coke, the damper behind almost closed, and left to itself for twenty-four hours, when it will be found to be still warm.

When the draught is extra strong, as it sometimes is on a clear, frosty night, or with the wind in the right direction, I damp it further by putting a piece of sheet-iron against the front, covering up the whole opening. Sufficient air leaks in to keep up combustion, which, however, is very slow and equal. An occasional canful of water to make up for the slight evaporation is all the attention it needs, a glance at the reservoir showing when this is required. The whole cost in my case did not exceed 30s., and one ton of coke lasted through last winter, and gave me an equable temperature with very little trouble. If in trying to follow my example any reader should have a difficulty, I will be glad to help him further through "Shop."

Fig. 10.

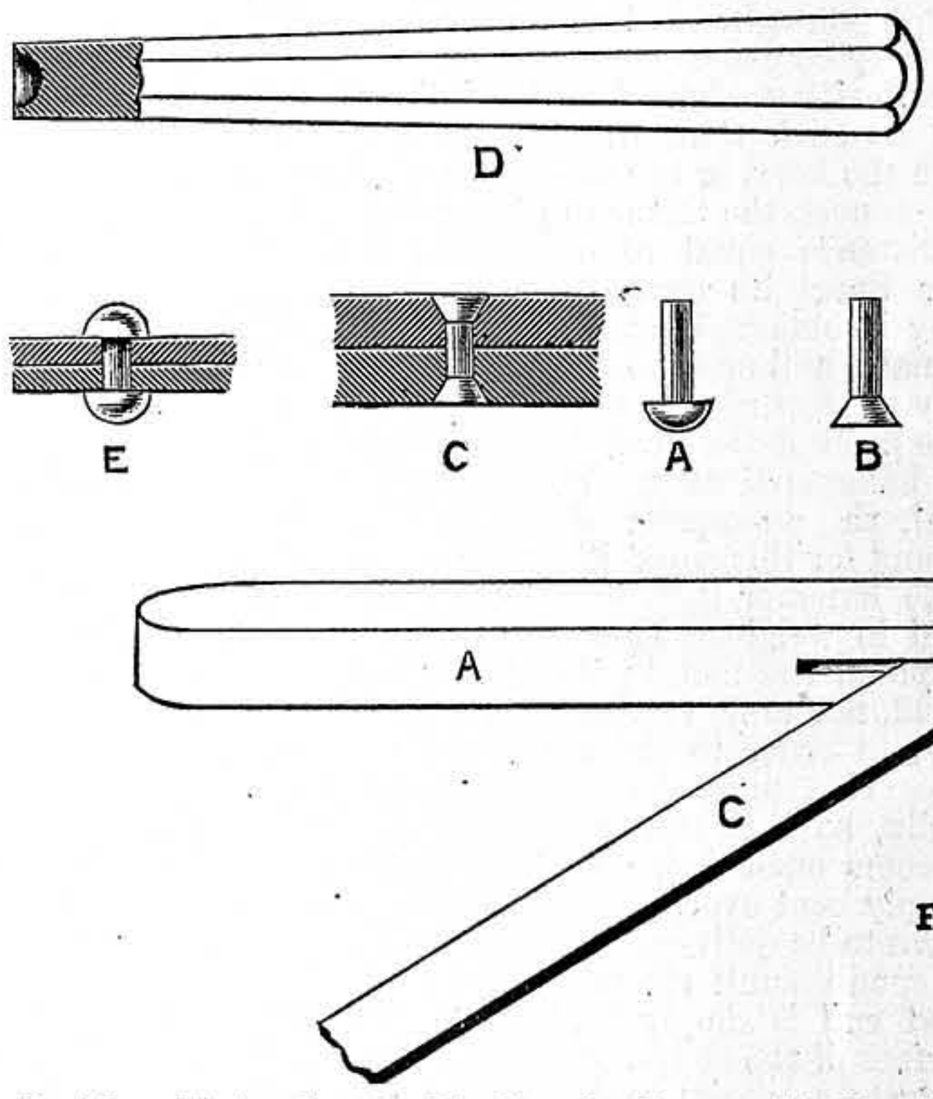

Fig. 11.

Bent Iron Work. Fig. 10.—Riveting Appliances. Fig. 11.—Method of Punching Holes.

BENT IRON WORK, AND HOW TO DO IT.

BY J. H.

THE FRAMINGS—METHODS OF UNION—SOLDERING—SOLDERING WITH THE COPPER-BIT—SOLDERING BY SWEATING-ON—BRAZING—RIVETING—PUNCHING HOLES—DRILLING RIVETS—HOW TO RIVET.

I SHALL write in this article of some of the principal elementary operations involved in the construction of the heavier portions of bent iron work.

The Framings.—Bent iron work consists of two portions, the framing or skeleton, and the ornamental parts. It is usual for amateurs, and especially lady amateurs, to purchase the framings, and only do the ornamental work themselves. This is expensive, and not satisfactory, and I do not see why the entire work should not be done by the amateur himself, for the sections of iron are never really heavy. There is very little indeed over about ⅛ in. and $\frac{3}{16}$ in. square, and about ⅜ in. in width by ⅛ in. in thickness; and all this can be easily heated to redness in a kitchen fire, and bent over an amateur's anvil or in the vice. There is no welding at all ever necessary in bent iron work; so that we may say that the forge operations on the larger sections are simply those of bending, and occasional tapering or thinning down of a section. How these are done I intend to show in the articles which I propose to devote to practical examples.

Methods of Union.—Then, further, in reference to the union of parts, there are three methods of uniting the heavier framings upon which the bent iron work is built; they are—soldering, brazing, and riveting. These are named in their order of relative increasing strength.

Soldering.—Soldering, or soft soldering, is employed, first in positions into which it would be difficult—in some cases impossible—to introduce the clips and the nose of the pliers for pinching them tightly.

Plenty of such instances occur in the smaller curves. The fastenings of larger curves are always easily got at; not so, many of those of minute dimensions. In such places a spot of solder will effect a perfect fastening, and there is no area so small that solder will not reach. If solder is not used in these cases, then the parts must needs be left in mere contact only, without any fastening. This is very undesirable, because the bent iron is so very slight that all the support available should be afforded to it, in order to compensate, as far as possible, for its own lack of rigidity.

There are two principal methods of soft soldering employed—that, namely, effected with the copper-bit, and that by the process of sweating-on; and each of these has its uses in bent iron work.

Soldering with the Copper-bit.—If work is to be united by the use of the copper-bit, then, before the ends are actually secured in place, just the surfaces which are to be united with solder must be filed clean and bright. They are tied together, either with soft iron wire, or with brass binding wire, or pinched with clamps or pincers, or by any other suitable means. After they are thus bound together, run in between the bright faces a little spirits of salts, in which zinc has been dissolved until effervescence ceases. Then take in the right hand the copper-bit, properly tinned and at a low red heat, and a stick of solder in the left; melt a portion of the solder with the bit, letting it run between the surfaces which are in apposition. The solder will follow the spirits of salts, and set firm in an

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instant. This is a method well suited to a number of small points of contact.

Soldering by Sweating-on. — For large surfaces the method of sweating-on is preferable. The surfaces to be soldered are cleaned with a file, are moistened with killed spirits of salts, and a thin layer of solder is melted and worked over each surface smooth and level with one of the flat bevelled faces of the copper-bit. The two surfaces are then brought into contact, pinched together, and heated up to the fusing-point of the solder, when amalgamation and union of the two soldered surfaces will take place. The requisite heat may be obtained from a clear fire, or from a Bunsen flame, or from a pair of red-hot tongs, used for pinching the parts together.

Brazing.—Brazing is accomplished either with the blowpipe, or in a clear fire. The surfaces to be united are cleaned by filing. The portions are then tied together with iron binding wire, or with soft brass wire. If the latter is used, it supplies the soldering material. If soft iron wire is used for binding, then spelter is employed for cementing. This is sold in various qualities in the shops—different grades fusing at different temperatures, to suit different metals and alloys. Any spelter will do for uniting iron. The spelter is powdered and mixed with borax as a flux, and with water, and strewn over the edges of the work. The borax should properly be fused first, to drive off its water of crystallisation. If this precaution is not taken, the borax will swell upon the work and displace the spelter. The mixed spelter, borax, and water are taken up with a spoon, and placed upon the edge of the joint; and when the temperature has been raised sufficiently with blast, the spelter and borax will fuse and run between the joints. Now the work must be removed from the fire. The edges will afterwards have to be filed smooth, as brazing leaves them very rough.

Riveting.—The making of joints with small rivets is a very simple matter. Even ladies taking up the bent iron work need find little difficulty in these elementary operations, and so become independent of the smith in the construction of frames.

There are two kinds of rivets—the cup or snap (Fig. 10, A), and the flat or countersunk head (Fig. 10, B). Either and each of these may be used in the construction of the frames for bent iron work. For thin iron the cup-head is best, for these reasons—the hole has not to be countersunk, which is objectionable in thin iron, weakening it much; and, unless it is countersunk, the flat head, standing up above the iron, keen and jagged, looks very unsightly. But the cup-head requires no countersinking, and forms a neat finish on the work. In some instances where it is desirable that the surfaces shall be perfectly level, then the holes must be countersunk, and the best job possible made of it. In the heavier framings — say, of $\frac{1}{16}$ in. thick and over—this is readily done.

The holes for the rivets are either punched or drilled. In the thinnest iron they are more quickly punched; in that of over about $\frac{1}{16}$ in. thickness they must be drilled.

Punching Holes.—To punch a hole, the iron may be laid upon the end grain of a block of hard wood, as shown in Fig. 5, page 6, No. 157. A steel punch, blunt at the end, but made keen at the edges, which is accomplished by touching the end on the grindstone, is then driven through with a single blow of a hammer. The disc which is punched out will become embedded in the wood, and the support afforded by the hard wood will prevent the formation of much burr. What there is will be filed off or hammered back, and the hole rymered out with the rymer shown in Fig. 6, page 6.

Another and better way of punching holes is shown in Fig. 11. A is a bit of steel bar having a slit, *a*, cut down at one end with a hack-saw. The steel punch, B, passes through a hole drilled through the bar. The iron strip, C, is passed through the slit and adjusted, and a single blow of the punch upon it forms the hole, and the burr passes through the bottom hole in the bar, A. This makes a keen, clean hole, and there is no need to use file or rymer for finishing it, because the strip, C, has a better bedding upon the iron than upon a wood block.

Drilling.—For drilling holes in a thicker iron any form of drill may be employed. One of the common archimedean drills is as useful as any for general work, and it has this great advantage—that it can be used on work which is in course of construction, in any position, and at any angle.

Rivets.—It is seldom or never that rivets of over $\frac{1}{8}$ in. in diameter are required for framings. For most work those of $\frac{1}{16}$ in. are large enough. Rivets of iron or of copper may be used.

How to Rivet.—The length of the rivet should be such that, when it is inserted through the holes in the two strips which it has to connect, the tail shall project through to a distance equal to about one and a quarter times its own diameter. A firm bedding is obtained, such as that afforded by a small anvil or similar block of iron, or even by the top of the vice-jaw; and upon this the head of the rivet is laid while the tail is hammered over. When hammering the tail, the cross-pane of the hammer is used; and for this work it must be narrow, and the hammer light—say, of about half a pound in weight. The aim of the blows is to spread the metal; therefore they are delivered, not only vertically, but also diagonally, in order to drive the metal outwards. This must be done equally and gradually, so that the spreading-out shall not become one-sided, nor the metal split, nor simply bent over. Several dozen blows will have to be delivered on a small rivet.

For countersunk rivets (Fig. 10, B) the battered end is simply filed off flush with the surface of the strips, as at C; with snap-head rivets a special tool, called a snap, is used for finishing. This (Fig. 10, D) consists merely of a bit of steel rod bored out at one end to a semi-circular form, and hardened. Two or three blows upon this, on the end of the rivet, will finish it neatly, so that nothing more need be done to it.

HOW TO MAKE AND WORK THE SPECTROSCOPE.

BY CHARLES A. PARKER.

PREFATORY REMARKS—REFRANGIBILITY OF LIGHT—NATURE OF PRISMS — SOLAR SPECTRUM — COMPOSITION OF SPECTRUM—FRAUNHOFER'S LINES—POSITION OCCUPIED BY PRINCIPAL LINES — USE OF SPECTRUM ANALYSIS—ABSORPTION BANDS — EXTREME DELICACY OF SPECTRUM ANALYSIS—VALUE OF THE SPECTROSCOPE TO THE ANALYTICAL CHEMIST AND THE ASTRONOMER — DESCRIPTION OF SPECTROSCOPE.

THE spectroscope may truly be said to be one of the few instruments which, during the past quarter of a century, have done so much for science—so marvellous, indeed, being its powers, that the minutest speck discernible by the microscope, or the faintest orb that the telescope can reach, may be subjected to a searching analysis which will reveal their inmost element, thus teaching the student the constitution of the sun and stars, besides placing in the hands of the analyst the means of recognising substances in quantities so minute as to escape all other methods of analysis. Nor is this all; for the spectroscope has been the means of revealing the presence of elements which would otherwise have remained entirely unknown. In short, spectrum analysis affords a means of testing various substances so delicate that its value to the analytical chemist can scarcely be overrated.

The cost of a good student's spectroscope, as usually constructed, places the instrument beyond the reach of the average student or amateur experimentalist; but, as it is not necessarily of elaborate construction, it can generally be successfully made by any amateur workman of ordinary ability. Before, however, turning to the constructive details, it will be advisable to explain as much of the theory of the instrument as may be necessary for the full comprehension of the subject.

Spectrum analysis may be said to be mainly dependent upon what is called the refrangibility of light, or property by which light, in passing out of one transparent medium into another of different density, becomes bent out of its direct course and suffers deviation, transparent media bounded by non-parallel planes, and called prisms, possessing this property in the highest degree. A prism for optical purposes requires but two refracting surfaces—that is to say, two perfectly plane surfaces which are not parallel, but brought together at one edge in the form of a V, the apex where the two refracting surfaces meet being called the refracting edge and the angle between them the refracting angle.

Most of my readers are doubtless aware that, when a ray of white light is passed through a circular hole in the shutter of a darkened room, and is received upon a white screen, we get a brilliantly illuminated disc of white light; but if a piece of triangular glass—or prism, as it is technically called—is placed over the aperture in the shutter, and in the path of the rays of light, the latter will be split up into its component portions, as it were, and we shall no longer get the round spot of light, but an oblong band composed of seven different colours disposed in the following order: At that portion of the band which is opposed to the apex or refracting edge of the prism, a vivid red will appear, which merges into a bright orange and then yellow as it approaches nearer to the base of the prism, the yellow in turn melting into green and then fading to an exquisite blue, which deepens into indigo and then violet as it nears the end of the band of coloured light, which, by the way, is called the solar spectrum.

A pure spectrum—that is to say, one in which the bands of colour do not overlap as in the above experiment—is obtained by passing a ray of sunlight through a very narrow slit, as in the spectroscope; but in doing this the spectrum will be found to be intersected by a number of dark vertical lines, four of which were first seen by Dr. Wollaston at the beginning of the present century; and in 1814 these lines were mapped out in a masterly manner by the celebrated German optician Fraunhofer, who employed a much finer slit as the source of light, and marked the position of the principal lines by the letters of the alphabet, and in recognition of his services these lines in the solar spectrum are now universally known by his name.

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The student will do well to acquaint himself with the position of these lettered lines in the spectrum, as they are now repeatedly referred to in works upon spectroscopy. By reference to Fig. 1, it will be understood that the A, B, and C lines occupy the red portion of the spectrum, whilst the D line is in the orange-yellow, E in the yellow, F in the green-blue, G in the indigo, H in the violet, and I at the extreme end of the spectrum. Fraunhofer discovered in the course of his investigations that these lines were present in every form of sunlight, either direct or reflected, and with prisms of every form and substance. After having carefully mapped out some six hundred lines or so, he directed his attention to the stars, and found that starlight also contained lines, but they did not quite correspond with the lines in the spectrum of the sun; and, after a somewhat lengthy series of experiments, he came to the conclusion that the shadowy lines must be caused by something existing beyond our atmosphere, and entirely independent of our earth.

As a result of subsequent experiments, it was shown that every substance or metal, when raised to a high degree of heat, will give its own particular lines of colour, by which it is readily distinguished, no two substances producing similar coloured bands in the same portion of the spectrum; so that, supposing a mixture of two metals is submitted to analysis, each one will be found to exhibit the coloured lines or spectra peculiar to itself.

When we view the spectrum of a solid body—for example, a bar of iron—which is heated to a red glow, it appears first as a red spot, which gradually increases to the orange and then yellow and green tints as the heat becomes slowly raised until the metal reaches a white heat, at which stage we obtain the complete spectrum. This phenomenon, which was found by Dr. Draper to be general with all liquids and solids, is considered to prove that light comes from an incandescent solid or liquid. Supposing, however, that the temperature is still further raised, so that the body flashes into vapour or gas, the spectrum will be found to vanish, its place being taken by disconnected bands of colour and darkness, the bands of colour differing in number and position according to the variation in the composition of the luminous flame; and as every compound or element, the vapour of which can be heated to incandescence without being decomposed, presents a spectrum peculiar to itself, we have a ready means of immediately distinguishing a glowing solid or liquid from an incandescent vapour or gas. Then, again, supposing the light-rays from a luminous body to be passed through the incandescent vapour of a similar substance, the latter will absorb precisely those rays which it would itself emit if it were incandescent, causing a series of dark bands to appear in the spectrum which precisely coincide with the bright lines characteristic of the luminous vapour of the element through which the rays have been passed.

As an example of the extreme delicacy of this method of analysis, it may be stated the Chevalier Bunsen, in one of his earliest experiments in spectrum analysis in 1860, had been examining some of the evaporated residue of Dürkheim spring water, when he was surprised to find that the spectrum contained a number of unfamiliar lines, evidently due to some new substance. He therefore evaporated *forty-four tons* of the mineral water, and after having separated

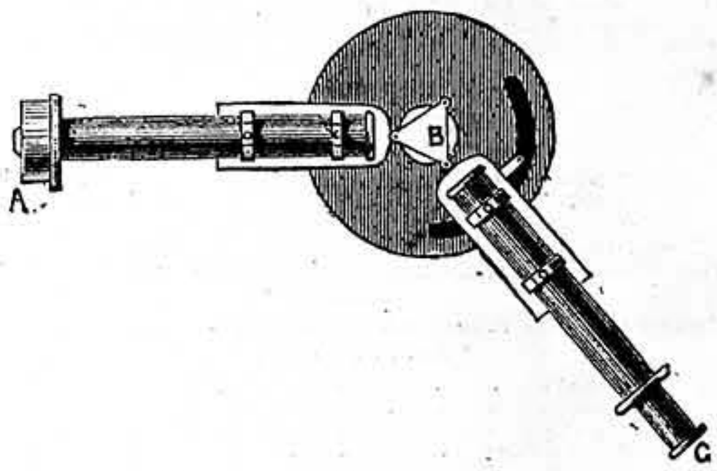

Fig. 3.—Plan of Table-top of Spectroscope.

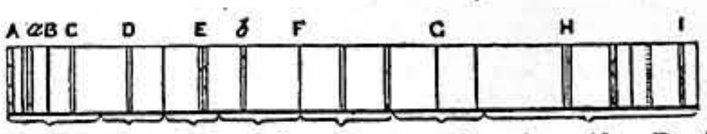

Fig. 1.—The Solar Spectrum, showing the Position of the Principal Fraunhofer Lines.

every known substance, found some *two hundred grains* or so of a mixture which proved to be the salts of two hitherto undiscovered metals, the first of which he named cæsium, from the greyish-blue of the lines in its spectrum, and the second rubidium, from its two intensely red lines. Since this period two other elements, thallium and indium, have also been discovered by the aid of the spectroscope, the former by an English chemist, Mr. Crookes, who named it after the splendid blue tint of its spectrum, and the second by German chemists, who also called their new discovery after its characteristic line, which in this case was indigo.

Every known metal has its own particular characteristic band of colour, and in no case are the bands of any two metals alike in refrangibility, so that the analytical chemist has a sure test for the presence of any particular salt. Then, again, with the alloys we find the same unmistakable bands of colour belonging to each metal: thus, with copper we have green bands; zinc, blue and red; and brass, which is an alloy of copper and zinc, gives the bands of both these metals, unaltered either in position or character.

As before stated, however, the spectroscope is not solely employed by the chemist for the detection of substances in minute quantities, but it is also of great service to the astronomer in investigating the constitution of the sun and stars; but for further explanation of this branch of the subject, and fuller particulars of Professor Kircher's discovery of the absorption bands, the reader must be referred to one or other of the many excellent works devoted to spectrum analysis, as the matter would occupy too much space in this journal, and, moreover, it is fully time to turn to the practical portion of the subject and describe the construction of the instrument by which these great agencies of Nature may be brought to light.

The spectroscope illustrated in Fig. 2 consists of a turned wooden pedestal mounted on a triangular base of the same material, supporting a circular table-top, to the upper side of which a couple of wooden arms are attached, one of these arms being made to move round the table on a pivot, carrying the observing telescope adjusted for a near focus, whilst the other arm, which is made a fixture to the table, supports a tube of similar length called the collimator tube, the outer end of this tube being provided with a vertical slit enclosed in a cap or hood, and made adjustable to any width by means of a milled screw on the outside.

By reason of the light entering solely through this slit, this latter forms the source of light so far as the optical arrangements are concerned; but as the light-rays would, in its present condition, radiate in all directions and fall upon the prism at different angles, it becomes necessary to employ a collimator, which consists of an ordinary convex lens placed at the other end of the tube at the distance of its principal focus from the slit, a small stop or diaphragm being located in the tube between the slit and the lens, in order to cut off all rays which proceed at too great an angle.

The prism is placed upon a slightly raised platform situated between the two metal tubes, so that the parallel rays from the collimator fall upon one of the sides of the prism, and are deflected according to their refrangibility, after which they enter the telescope, where they may be observed by the student, in the form of a long, narrow band of colour.

Fig. 3, which is a plan of the table-top of the spectroscope, shows more clearly the disposition of the various parts, and will doubtless aid the above description. The rays of light entering the spectroscope from the slit, A, of the collimator tube fall upon the prism, B, and in passing through this they become bent out of their course towards the base, and, being picked up by the telescope, are observed by the student at C in the form of a brilliant band of colour.

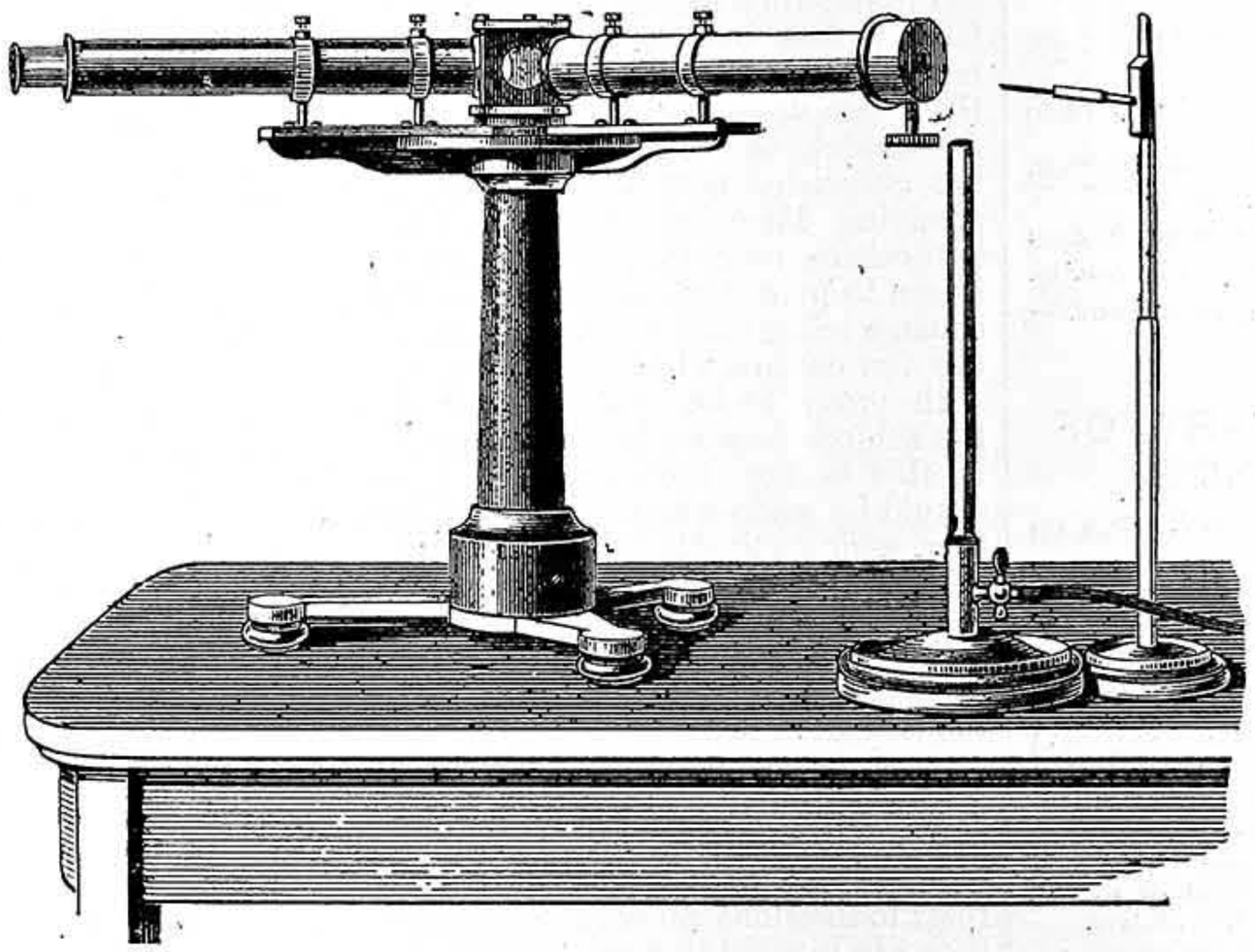

Fig. 2.—Spectroscope arranged ready for use.

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COINAGE.—We should have to revert to a rather remote period in the history of the country to find an epoch when the coinage, in design, if not in shape, was in a more discreditable condition from an artistic point of view than it is now. The last issued figure of the reigning monarch is the least satisfactory that has appeared upon the currency during the present reign—the set of the crown upon the head being particularly ungraceful, and seemingly insecure. It is not surprising that the question is again receiving attention at the hands of the authorities now that circumstances have arisen to permit of another alteration in the coinage being considered. All will rejoice if the new designs which are being proceeded with prove to be of a character worthy of the subject they are intended to emblemise. If this be not the case, then the designs should be made a matter of public competition, with a suitable money grant for life to the designer of the selected work. So far as the present coinage is concerned, the only artistic part of it worth retaining is Petrucci's excellent representation of St. George and the Dragon.

COAL.—400,000 men at work is no mean matter when the reflective mind turns to the results aspect of such labour; but when such a vast number of men turn from their industrious pursuits, and take to what they are pleased to term "play," the situation becomes a grave one indeed, since the issue of such a course must prove disastrous to all concerned. This state of things has been characterising the coal trade during the past few weeks. An exodus has taken place from the under world—horses have been brought up; tens of thousands of men who are better employed when dissecting the earth's strata than in any other occupation have emerged to its surface; and earnest measures have been carried on for a great trade struggle. At the opening of the winter such a campaign would have been fraught with gloomy prospects for society at large. As it is, our fitful climate has favoured us with some warm weather, which will have done more than all the trade delegates to bring the crisis to an end. The situation, however, brings with it its lesson. Inventive minds will have to turn their attention to compounds which will serve as substitutes for coal. There probably exist ample materials for a new kind of fuel, and in these days of advanced chemical science and business enterprise, there is little to stop the way to almost untold wealth, and at least one whole nation's gratitude, for the fortunate discoverer of the right compound. Certain properties it would need to possess. It should be slow burning, heat giving, and gaseous, and if it could be smokeless—well, the inventor of such a coal substitute would deserve a place in the calendar of the world's greatest benefactors.

WORKERS' HOLIDAYS.—After a season as cheerless, inclement, and erratic as our winters are wont to be, the thoughts of those who share in what are known as "holidays" are naturally beginning to turn in that direction. This break is always a comfortable reflection for a large section of the community who readily accept the recognition of some temporary cessation from their toil, mainly because they claim to belong to, and are content to be ranked among, that not always distinguishable body of toilers known as "brain-workers." A less favoured community are the factory hands, the men at the bench, in brief, the weekly wage men who, year after year, toil and spin without cessation. Workers' holidays constitute a quantity which has not, so far, been taken into consideration in the great problem of capital and labour, etc. The mere suggestion of such a thing as workers' holidays will strike terror into the minds of those burdened with the responsibility of converting labour into profitable financial results, as forming yet one more element in the vexatious struggle in which the capitalist has to engage. Nevertheless, the subject is one which ought to be urged and considered. In this advanced age, and with all our progress schemes and ameliorative processes, it is lamentable that throughout the country a recognised principle obtains by which toilers labour on year by year with only such remission from their task of daily toil as the Bank Holiday Act affords. We submit the suggestion of workers' holidays as one worth the attention of all employers having long-service workmen. A week's holiday in the summer—at, of course, the worker's own expense—would probably serve him better than any shortened hours of daily labour. It might suit the employer equally well. Such a scheme would give workers time and opportunity to improve physically and mentally, and there is little doubt that the occasion would be turned to good account by every reasonable man—and there are such, even in the factory and workroom. If organised workmen's summer holiday and pleasure trips, especially to the Continent, could be arranged between men, masters, and the unions, this would spell not a little in the emancipation of the workers of this great country. It is impossible to estimate the salutary effect which an acquaintance with some of the art treasures of, say, such a city as Paris would have upon intelligent craftsmen who could participate in such a scheme as the one briefly indicated. The wealthy man can summon his yacht or "special" and go whither he will; while the rich middle-class can enjoy their personally conducted tours. Why should not some Cook or Gaze come to the rescue with plans for operatives' holidays?

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NOVEL STAND FOR GOLF CLUB.

BY J. W. HODGE.

INTRODUCTION — BASKET — STEADYING BLOCKS—BALLS—CLUBS, SHAFTS, AND HEADS—TRAY—ORNAMENTAL EDGING—PAINTING — ALTERNATIVE TRAY.

Introduction.—Among the devotees of golf there must be a large number possessed of a practical turn of mind, or others, again, who may be desirous of "killing time" profitably, and to either class this paper will prove interesting. An article which is ornamental as well as useful, and easily manufactured by the golfer himself, at a trifling cost, from materials within his grasp, is certain to be appreciated. What golfer is there who has not lying about him relics of his muscular powers, in the shape of broken shafts, cracked club heads, or beautifully hacked balls—all or any reviving memories, pleasant or melancholy, or even humorous, of the splendid victories or regrettable defeats of a bygone season? With old friends the golfer is loth to part. These remnants of his dear old implements are clung to with wonderful tenacity, and are kept knocking about, it may be, in the corner of a room or lobby, where they prove a source of endless worry and anxiety to the tidy housewife. But this chaotic state of affairs need not exist, when a handy contrivance can be made which is sure to preserve order. When finished the stand will be to the possessor (and all the more so if he himself has made it) "a thing of beauty" and "a joy for ever," for he will never tire of dilating on the historical points of this or that club or ball.

The sketch produced (see Fig. 1) gives a general idea of what is more fully described below. The dimensions are taken from one made by the writer—an enthusiastic novice—but should these not suit the requirements of his more experienced brother, whose stock-in-trade is much more extensive and complicated, it will at least provide him with a plan to work upon.

Basket.—Procure from any fancy stationer a small wicker basket (circular), commonly used for waste paper, measuring 12 in. long and 7 in. in diameter. Carefully remove the bottom, and see that the bands at the extremities are properly secured. Down the sides, with a pencil, mark three lines equal distances apart; on each of these lines, 2½ in. from the one edge and 1 in. from the other, bore holes sufficiently wide to take in a ¾ in. screw nail.

Steadying Blocks.—Get a piece of hard wood, fully 1½ in. broad and about ½ in. thick; taper off with small plane on both sides to edge until the end assumes the shape of A in Fig. 2. Cut off six pieces to pattern B, and bore in centre of each a hole which will give easy access to ¾ in. screw, taking away at same time from one side enough wood to allow for sinking of head. These clamps, which are inserted from inside of basket, will be found inestimable in answering the twofold purpose of preventing the cane from splitting and—what is perhaps even more essential—steadying the whole structure.

Balls.—These (six in number) may be old, useless "gutties," heated and re-grooved according to the ingenuity of the operator; but should he not be inclined to go to so much trouble—for undoubtedly the process *is* a troublesome one—he might purchase the requisite number of common

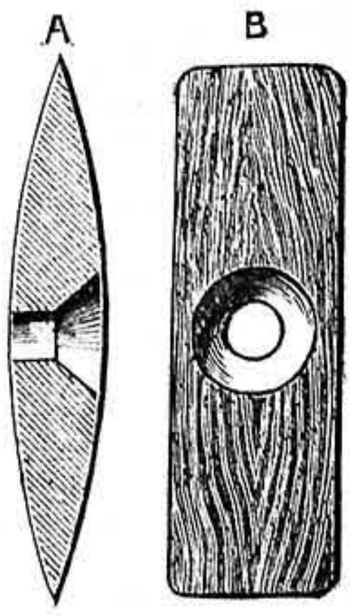

Fig. 2

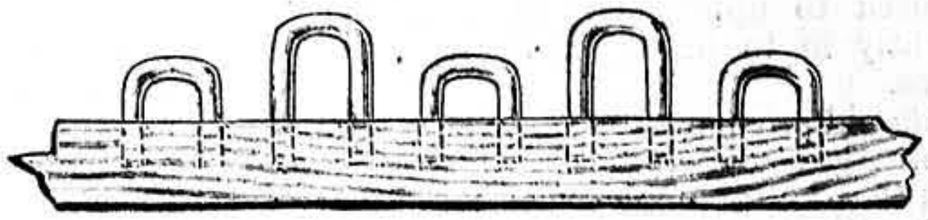

Fig. 6

Fig. 4

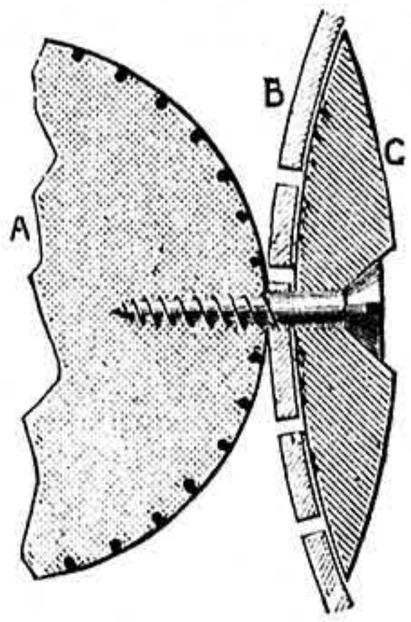

Fig. 3

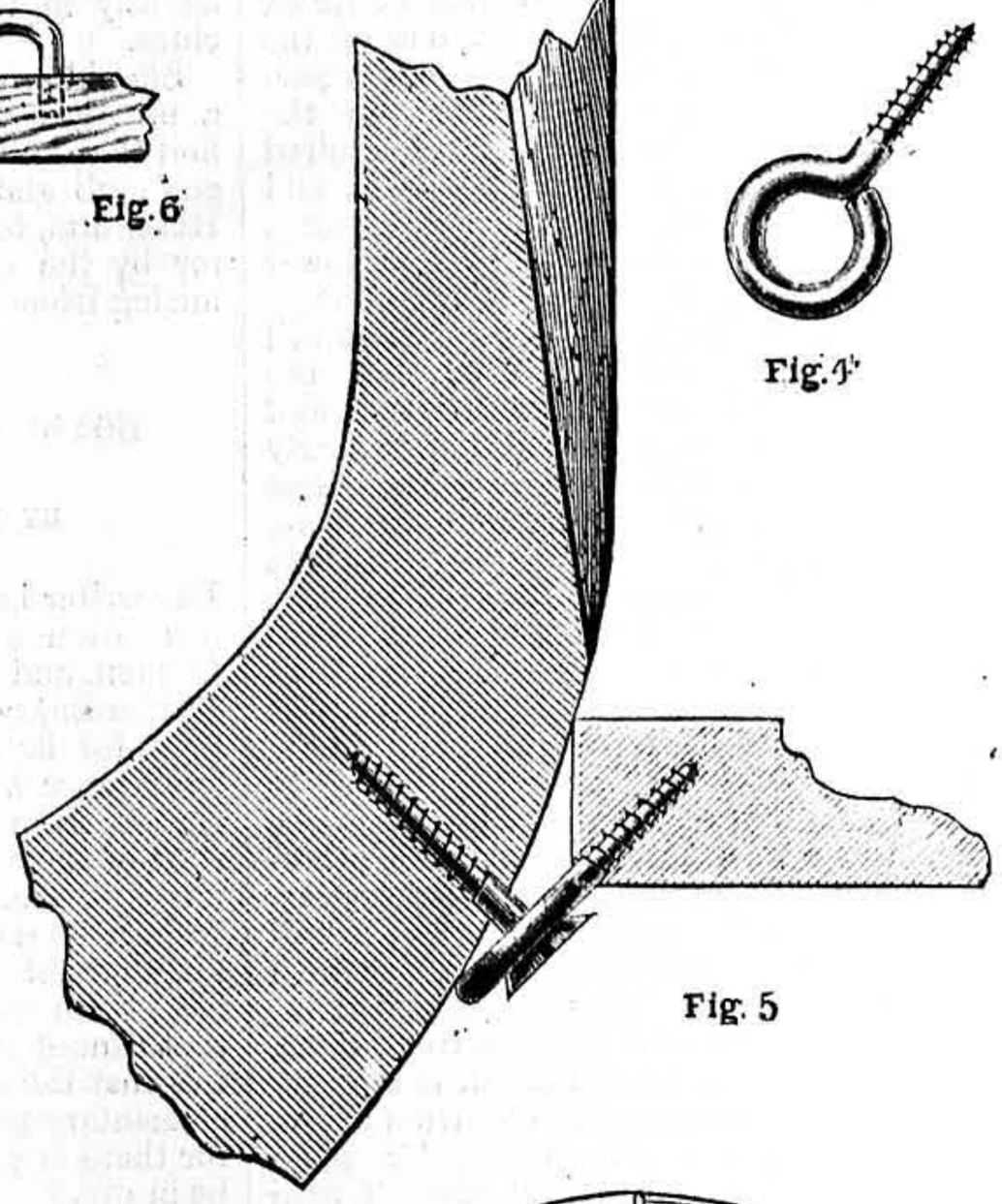

Fig. 5

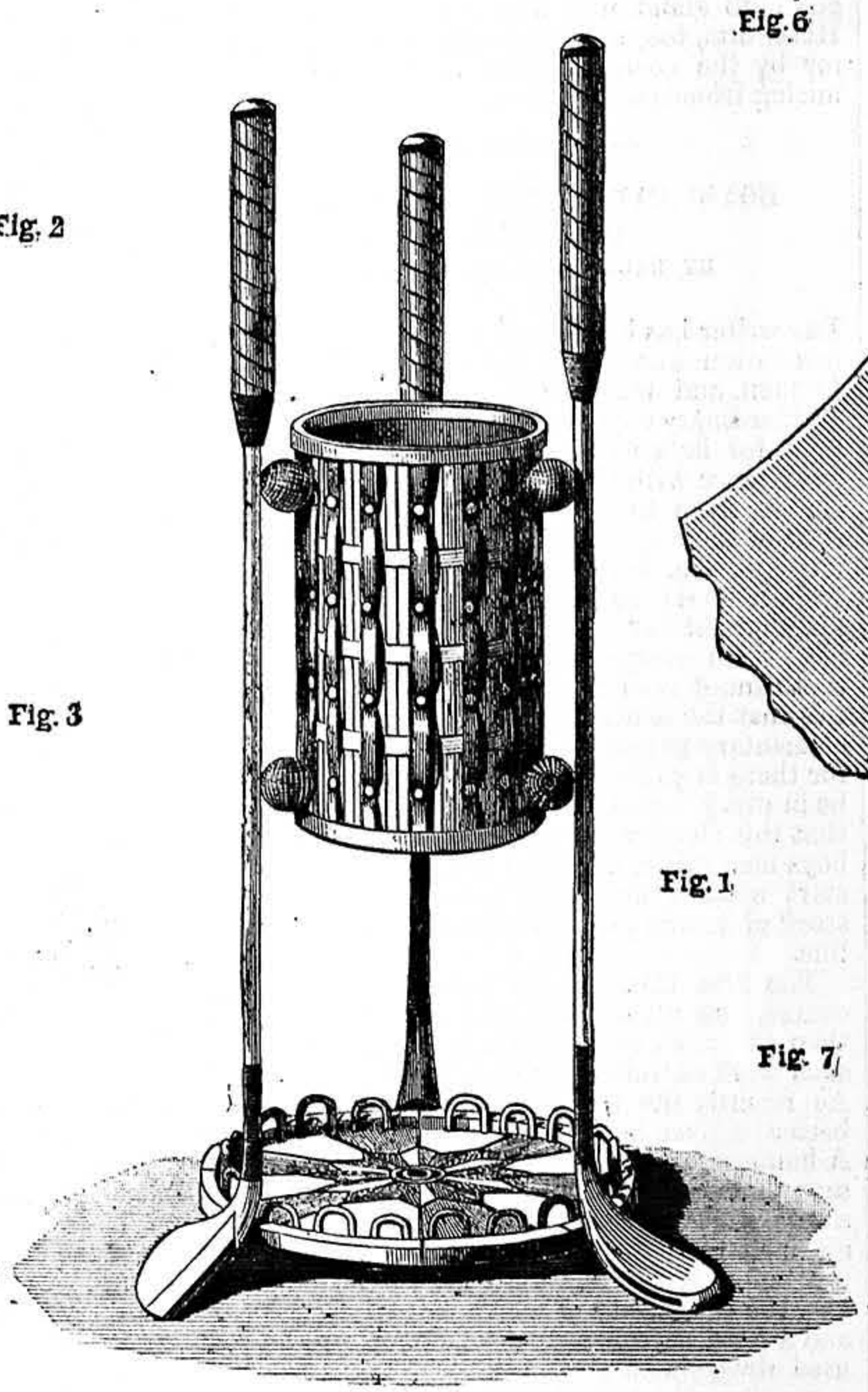

Fig. 1

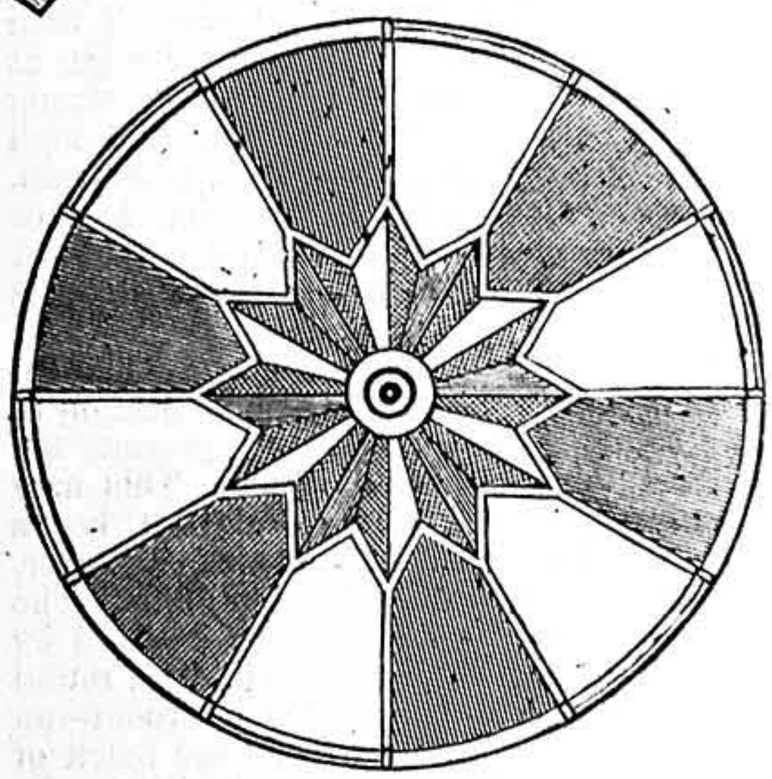

Fig. 7

Fig. 7A

TERRA COTTA No 1

" " " 2

" " " 3

Novel Stand for Golf Club. Fig. 1.—Stand complete. Fig. 2.—Cross Section and Front View of Clamp (full size). Fig. 3.—Cross Section, showing how Ball, Basket, and Clamp are fitted together. Fig. 4.—Eyelet through which Tray is fixed to Club Head. Fig. 5.—Method of joining Tray to Club. Fig. 6.—Showing how Hoops are erected. Fig. 7.—Design for Tray with Explanatory Note (Fig. 7 A) as to Colour.

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"sixpennies" or "re-makes" from any club-maker, and the result will be much more satisfactory to the eye. Through the holes made in the basket, and with the aid of the clamps already mentioned, the balls can now be fixed in position, and the method will, perhaps, be better understood by a glance at Fig. 3, which shows how ball (A), basket (B), and clamp (C) are united.

Clubs.—Select from the "incapacitated" the shafts most easily "doctored," and with fine cord and a little putty do all the necessary splicing and filling of holes or cracks. Pick out the three shafts having the tidiest "leatherings," and to each of these, for the time being, loosely fix one of the selected heads. Stand the clubs in a perpendicular position with the toe on the ground, and measure for the sizes required—viz., 2 ft. 10 in., 3 ft., and 3 ft. 2 in., and should any of the shafts require shortening, remove head and cut surplus from lower end. Let the angle be exactly the same as before cutting, else the height aimed at will be altered. By gluing and warping, the heads can now be firmly secured to shaft, and the result will be a club resembling, in nearly every respect, one for ordinary use. Rest the clubs in an upright position once more, and from ground, 15 in. up shafts, bore a hole and fasten with inch screw nails to balls attached to basket, 1 in. from edge. Find the distance from the centres of two balls on one line of basket (which should be about 9 in.), mark off on upper portion of shafts from last hole, bore, and fix as before to balls, 2½ in. from upper edge. Care must be taken to make exact measurements, otherwise the stand will present a twisted appearance. See, likewise, that all screws are well sunk and the holes obliterated, either with putty or a mixture of glue and sawdust.

Tray.—All that now remains to be done, to complete the structural effect, is the tray for the clubs to rest upon. Cut from a ½ in. board, with a bow-saw, a circular piece fully a foot in diameter, and smooth with plane and sand-paper. On lower edge, at regular distances apart, screw three strong eylets (Fig. 4) right up to ring. Through each of these, with a strong ¾ in. screw nail, attach tray to club heads, allowing a space of about 2½ in. between tray and ground. A reference to Fig. 5 will indicate how this is done.

Ornamental Edging for Tray.—The introduction of some simple ornamentation to take away the plainness, and prevent the clubs slipping off, is advisable. This may consist of a series of miniature hoops (eighteen in all), made from thick cage-wire, cut into two lengths of 4 in. and 6 in. The regularity of the curve may be ensured by bending each piece, from the middle, round the handle of a long kitchen broom—an article which is surely within the reach of all. Fix these, large and small alternately, on upper surface of tray, in an upright position (see Fig. 6) at regular intervals from one another, and about half an inch from edge, into holes pierced half-through with a small bradawl, suitable to the thickness of the wire used.

Painting.—Here will be found great scope for artistic taste. Taking as a guide the stand which is responsible for these details, the shafts might be painted with terra-cotta enamel, No. 2 (Aspinall's was used all over); the warping at junction of head and shaft with terra-cotta, No. 3; the head black, with a white facing; the bone and lead grey; and the balls, of course, white. The painting of the tray could be made a special feature; and the sketch (Fig. 7), besides giving the design, will show how the writer went to work with three shades of terra-cotta. When these are dry, the outline of the star should be gone round with a fine line of white, and from each point to edge of board a line of the same will enhance the effect.

Alternative Tray.—Those who do not care to go to so much trouble in making and painting the tray will find a simple substitute by using an ordinary Japanese tray with inch rim. The mode of attaching to shafts, however, would be somewhat different; the eyelet screw would require to be secured to upper edge of rim, and bent slightly in to meet the slope on back of clubs.

Should anyone be induced to carry out in a practical way these instructions, he will find that for a lobby or hall ornament the golf club stand will take a lot of beating. His efforts, too, will be amply compensated for by the complimentary remarks of admiring friends and visitors.

BOYS' CARPENTRY—RABBIT HUTCHES.

BY LAUNCELOT GUBBINS.

THE writer has been through that wonderful institution known as the People's Palace, London, and was greatly struck with the extraordinary opportunities that are afforded there for lads to obtain that practical acquaintance with the various trades that will enable them to take a bold stand at the start of their apprenticeship, that was quite impossible hitherto. I only wish that such schools could be established all over the kingdom, but of course it is not possible to have them everywhere, and it is such boys that cannot avail themselves of such facilities that the Editor hopes to reach in these elementary papers on "Carpentry for Boys," for there is no reason why WORK should not be in every house in the land; and I hope that this chapter on rabbit hutches, which boys may make, may lead some of them to start what I hope will prove hereafter a stock of lasting information in the carpentry line.

The first thing to be considered is, of course, the capabilities of boys generally, then the tools they shall require, and next such work as would be most suited to them. As regards the tools, I think a list had better be given here of what we shall require: A hammer, and what is known as a pruning saw, pincers, one or two awls, a jack knife, a rule, a chisel or two—say a half-inch and an inch one—a spokeshave, a brace and a few bits, a light axe known as a gardener's axe, the peculiarity of which is its lightness and a long, narrow-shaped blade (this to be used always with great caution), a square—a wooden one will do very well until we become more proficient—and after a time a light jack plane.

In writing this article I shall not go to any pedagogue-like means of explaining what the tools are for in each case. I shall premise that our boys at least know what the tools are for before they buy them. Nor shall I go into a long dissertation on the fibre and peculiarities of the various sorts of timber. I shall, I am sure, be better thanked by "skipping" all that, and—our impatient boys will think—a good deal of the introduction as well.

How to make a Rabbit Hutch.—Well, I shall take it that we know the names of all the elementary tools and their uses, and I shall now describe how to make a few articles indispensable to boys, and I shall begin with a rabbit box or hutch. The first thing to do is to find out how much wood we require and obtain it; and as we are only commencers we shall fall back on old packing-cases and boxes of that sort for timber to experiment on. A very good form of rabbit box is made plain square with two divisions, one for the animals to sleep in, and the other for them to feed in, with what is known as a lean-to roof, which may be covered with felt and tarred, if it is to be exposed to the weather, but which is most likely to be kept in the back house, and which, in this event, will not require any waterproof roofing. The size for a hutch to hold, say, a pair of rabbits will be about 24 in. long, 24 in. deep, and 18 in. high in the front, sloping down to 12 in. high at the back. The first things to get are two sides 24 in. long and 18 in. high at one end, and 12 in. high at the other, and about ¾ in. thick. But as timber 18 in. wide is not to be had, as a rule, we shall have to put the pieces together to make up the required thickness. This may be done in several ways, but about the easiest way is to lay the narrow boards edge to edge and to nail narrow strips, technically called cleats, down to them at right angles, so that the whole is firmly held together (see Fig. 1, and observe the position of the nail-holes). After the nails are driven through they are clenched at the other side—that is, they are bent over so that they will tighten the wood together and not come out again except by the use of very considerable force. A glance at the old packing case will show us how this is done; the points of the nails will, by this operation, be turned in so as not to do any damage. The top edge will now be cut to the required slope, and when the sides are finished they are nailed to the edge of the piece forming the back, which will, of course, be 24 in. long and 12 in. high. The partition (Fig. 3) is next to be made in the same way and fitted into its place; it has two small doors for the exit and ingress of the "bunnies," cut out with a pad saw if we have one; if we have not, with an ordinary saw as far as we can go, and the rounded top with a strong jack knife. This partition is put into its place, leaving a foot deep for sleeping space and a foot for feeding space, not counting the thickness of the partition, and will be kept in position with nails driven through the sides. We will, in putting the sides together, and in all cases, keep the cleats as much out of sight as possible.

That disposes of the sides, back, and partition. The roof is then put on, which consists simply of the thin pieces laid on to the sides and nailed into position one after the other. We will try with our square to ascertain whether the edges are true before nailing the parts together, as if they were not quite square the resulting house would be lop-sided. Next comes the front. This will require a little patience, and consists of narrow rails, which will be made from pieces of timber of, say, 1 in. square; they are neatly rounded, first with the axe or chisel and then with the spokeshave, which is one of the most useful tools in our kit. These rails are cut to the proper lengths and fitted into holes bored in the top or roof along the edge, and also along the edge of the bar which runs across the front at the bottom, in the case of a hutch having no floor, but bored into the floor itself, if a fixed one. The holes will be about 1½ in. apart. The rails will be made to protrude through the holes in the edge of the top, and cut down the centre with the saw, and a wedge will be

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driven down to keep them tight in position, and the surplus wood cut off with the saw and nicely trimmed with the chisel or knife (see Fig. 4). The holes will be bored with a brace and bit; a useful size bit is $\frac{5}{8}$ in. If we can afford it we shall get Jennings' double spur bits; they are far and away the best, but being beginners we shall require to take great care of them. They do not require any force to drive them; the taper screw on the end works its own way into the wood, and we must be careful of this screw, as it is very delicate, and if broken off the bit will cease to be of any service. Ordinary centre-bits are infinitely cheaper, and perhaps will be good enough to commence with. The door of the house is made, it will be seen, of three of these bars, which go up right through the roof (they will, of course, be cut a little longer than the others), and are let into a piece of wood with holes bored in it also, and wedged into the piece of wood instead; this bit of wood forms a handle to the door. The bars at the lower end of the door are secured by a bit of wood similar to the last, only made a little longer, and shaped with half a hole at each end, so as to fit up against the rails at each side of it, and thus keeps the door straight and steady (see Fig. 5). In the case of hutches with no floors, a long, narrow piece of wood about $1\frac{1}{2}$ in. square will be nailed to the front bottom corners of the sides, and forms, after the holes have been bored in it, the bar into which the rails fit.

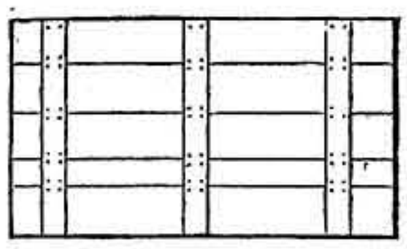


Fig. 1.

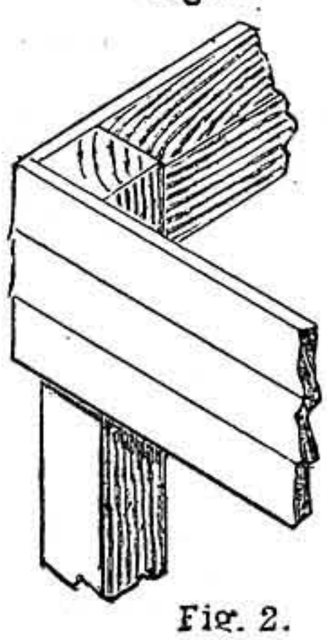


Fig. 2.

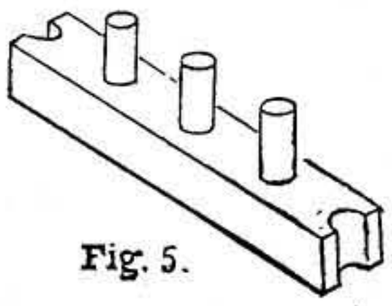


Fig. 5.

Another mode of putting the box together would be to get square scantlings of timber of, say, $1\frac{1}{2}$ in. square, and nail the boards on to these as required (see Fig. 2); the scantlings give extra strength as corner pieces, and do away with the necessity of cleats. Rabbit boxes, as a rule, have no bottoms, but if any reader thinks his would be better with one, it can easily be made in the same manner as the sides, and when made can be fitted to the bottom and left loose in order to be cleaned from time to time, or nailed into position from the sides down at the bottom edge.

From these instructions in working up rough wood the beginner can easily see what other things not requiring great skill can be constructed on the same lines. Small chicken coops and dog kennels, wall pigeon dovecotes, and such like necessary and useful articles can all be made in this manner with scarcely any labour or outlay.

In my next paper I shall take it that we are getting a bit proficient with the tools, and will explain how to construct a few small articles, such as brackets, salt-boxes, knife-trays, and such like out of odd pieces of timber that we may have left over, and how to make ordinary picture frames. In the meanwhile, if there is anything which any boy does not understand, he has only to write to me through the Editor of WORK and I will explain anything respecting dealers for tools, wood, etc., through the always welcome pages of "Shop."

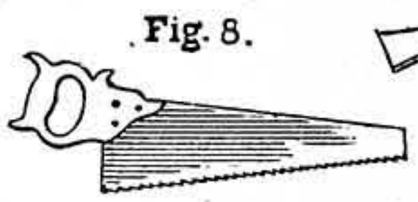


Fig. 8.

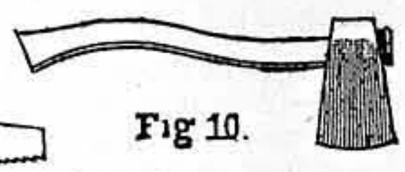


Fig 10.

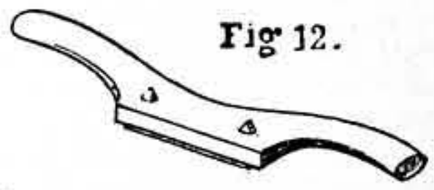


Fig 12.

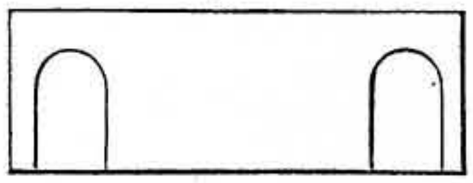


Fig. 3.

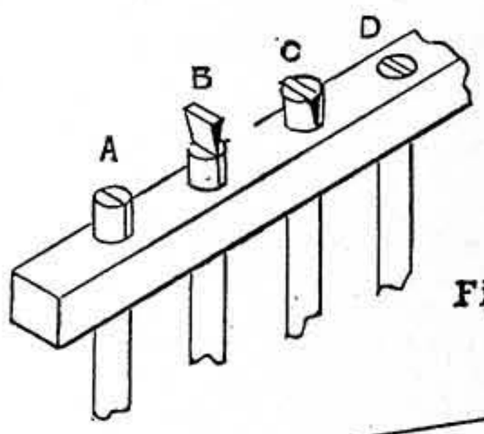
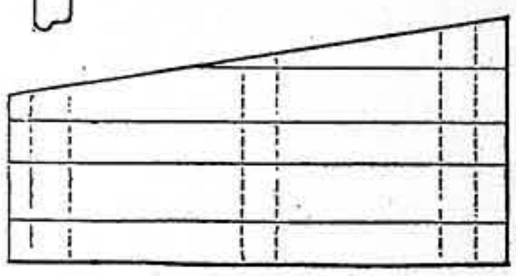


Fig. 4.



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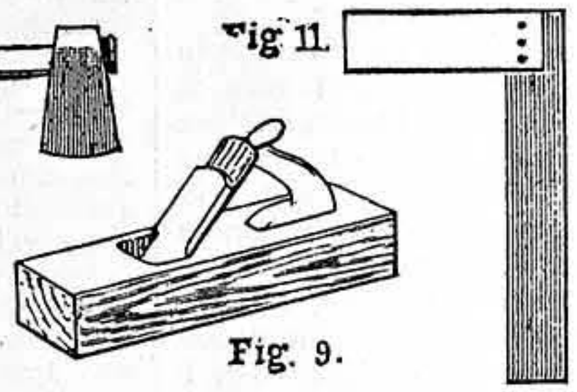

Fig 11.

Fig. 9.

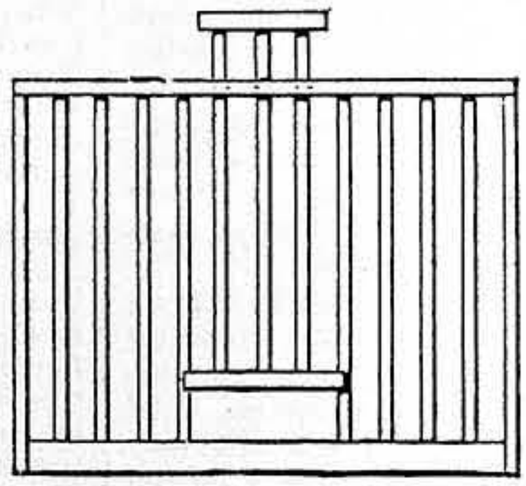

Fig. 7.

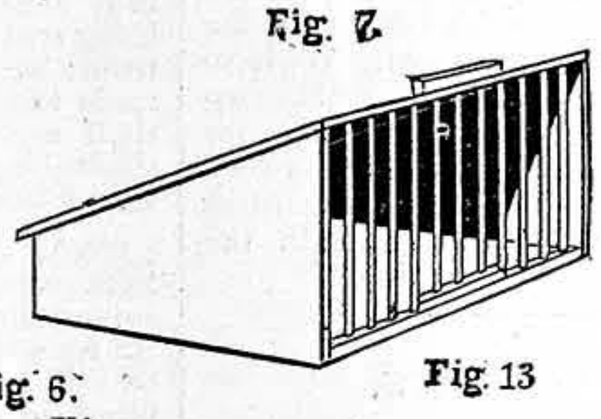

Fig. 13

Rabbit Hutches. Fig. 1.—Manner of laying Boards to be cleated. Fig. 2.—Another way of building up Boards. Fig. 3.—Partition. Fig. 4.—Manner of securing Rails by Wedges—A, Rail with Saw-cut; B, Wedge ready to be driven; C, Wedge driven home; D, Wedge and End cut and cleaned off. Fig. 5.—Bottom of Door. Fig. 6.—View of Side. Fig. 7.—View of Front (Door partly open). Figs. 8, 9, 10, 11, 12.—Various Tools. Fig. 13.—General View of Rabbit Hutch.

CRAFTSMEN'S PRECEPTS.

BY P. B. H.

REMEMBER:—That wooden surfaces cemented by glue *newly made*, and in dry weather, will hold much better than when done in wet weather, and with glue several times re-heated.

That saltpetre and sulphur may explode if pounded in an iron mortar.

That sugar mixed with ordinary ink forms a good copying ink.

That quinine will preserve paste, etc.

That in mixing acids and water, the acid must be poured into the water, and not the water into the acid.

That carbolic acid is combustible.

That 31 grammes make 1 oz. troy.

That 175 lbs. troy = 144 lbs. avoirdupois.

That lbs. avoirdupois × 1·2153 = lbs. troy.

That lbs. troy × ·82286 = lbs. avoirdupois.

That the diameter of a circle × 3·1416 = the circumference.

That the square of the diameter × ·7854 = the area.

That the side of a square × 1·128 = the diameter of a circle of equal area.

That one metre = 3 ft. $3\frac{3}{8}$ in. English.

That one cubic foot of pure water = 62·425 lbs.

NOTES FOR WORKERS.

AN improved form of casing for the protection of electric cables has been brought out. It is made of the toughest steel, carefully galvanised to resist corrosion, and is very strong, flexible, waterproof, and is lighter than iron wire armour.

THE necessary machinery for furnishing power at the Chicago Exhibition will be secured nearly free of cost, as the exhibiting manufacturers of engines, pumps, etc., will supply power gratuitously.

A NEW magnesium lamp has been devised, which burns without attention for periods of 24 hours. It takes about 100 hours to burn 1 lb. of magnesium, and the light produced has an intensity equal to that of 130 candles.

THE artesian well at Springfield, South Dakota, U.S.A., is one of the largest in the State, has a pressure of 200 lbs., and throws up a stream 30 ft. high. Lately it has been throwing up soft coal and slate, and there are already $1\frac{1}{2}$ tons of soft coal scattered round the well.

THE Institution of Civil Engineers consists of 1,760 members, 3,095 associate members, 413 associates, 17 honorary members, and 854 students.

WATER constitutes more than two-thirds of the weight of the human body.

A NEW hand camera, called the Photomnibus, has been brought out. It has no lens, but a pinhole in front answers the purpose.

ALUMINIUM gold is an alloy of nine parts of copper and one part of aluminium. It is much harder and lighter than gold, but becomes tarnished in course of time.

PROF. KAUFMAN, of the Veterinary College at Atfort, has discovered that chromic acid, used hypodermatically, will destroy the poison of snakes. A one per cent. solution is cautiously used with an ordinary hypodermatic syringe.

ELECTROLYTIC copper is coming more into general use, owing to its great purity. The first electrolytic factory was established at Hamburg, where a powerful Gramme machine (3,000 ampères) was constructed in 1872 for galvanoplastic operations.

THE daily output of electrolytic copper at the Hamburg works during 1891 was $25\frac{1}{2}$ tons. The strength of the current used was 25 to 30 ampères per square metre of cathode surface.

THE velocity of light is 186,700 miles per second, and it only takes $16\frac{1}{2}$ minutes for light to travel across the earth's orbit, which is about 185,000,000 miles.

ALL bodies expand on heating, the few exceptions to this rule being silver iodide, stretched caoutchouc, water below 4° Cent., and some alloys, which contract when heated and expand on cooling.

A HARD cement, which resists the action of acids, may be made by mixing a strong solution of zinc chloride with zinc oxide to form a thick paste.

THE largest electric light plant in the world is to be erected in Chicago by the Edison Co. at the cost of $2,000,000.

To make lime-water, add 2 ozs. of slaked lime to a gallon of water and stir well. After standing several hours, the clear lime-water can be drawn off the deposited excess of lime.

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EMIGRANT FIELDS AND PROSPECTS.

OTTAWA. — Time for Emigrating — Building Trade Unpromising — Good Prospects for Electricians.

Acting upon the promise contained in the prospectus of the present volume of Work, we have now the pleasure to present to our readers the first of a series of letters bearing upon the all-important subject of emigration—a matter involving such momentous issues to those directly concerned that only such information as that emanating from special and direct sources—from those, in fact, who have tried the various districts for themselves—can be really valuable. Such personal experience is given in the following letter; and we trust that, while it will encourage some to act upon the advice offered, it will also deter others from trying a spot, the latest information in respect to which is not favourable to one section of workers—the building trades. **J. J. (Ottawa, Canada)** writes:—

"The present time is a good one to come to Canada, and I believe that any man who is willing to strive, and is of sober habits, can get a living here better than in England. I came out from London some twenty years ago, and have never regretted doing so, as I have always been able to earn enough to keep me comfortably. Although I have not made a fortune, I have established myself in a good business, and can always put my hand on a few dollars when I need them. Living is better and cheaper than in England, but I would advise anyone coming out to make way to Ottawa, or go even farther west, rather than stop east, as the western towns and cities are more English, and the climate milder. The summers here are as relatively hot as the winters are cold. Being always sheltered where I am, I prefer the winter. The building trade will not be very brisk in Ottawa this coming summer; but anyone understanding electricity or any of its branches would be sure of employment. We have three electric light and power companies here in full blast, the city being nearly wholly lighted by electricity; while street cars, printing offices, machine shops, baking machinery, and flour mills are run by it. We have an immense water-power here, and there is every appearance of this being one of the centres for electric light work in America. There is very little demand for good finished bench carpenters here, as all the house work is made in the mills."

SCIENCE TO DATE.

Artificial Bitumen.—On warming resin with sulphur to 250°, sulphuretted hydrogen is given off, and a nearly black substance is obtained, which possesses most of the properties of bitumen. It is insoluble in alcohol, but dissolves in chloroform and benzine. It is also sensible to light, and can replace bitumen in photography.

Flame Coloration.—The colour given to a non-luminous flame by certain metals and their salts—as for example, the yellow coloration produced by sodium salts, green by copper, etc.—has hitherto been considered a physical effect due to the incandescent vapour of the metal. Prof. Smithells has, however, noticed, by means of his flame-separating apparatus (described last week), that a copper salt brought into the inner cone does not produce any coloration, but only a feeble luminosity, while the outer cone is tinged green in the usual manner. Hence it seems that the green coloration is due to a process of oxidation, and is not due to the mere incandescence of the vapour of the metal.

Rust from Nickel-plated Articles.—According to *La Nature*, the following method may be used for this purpose. The rusted surface is first greased, and a few days later it is rubbed with a rag soaked in ammonia. If there are any stains left, a little dilute hydrochloric acid is applied and then rubbed off. The article is then washed in water, dried, and polished with tripoli.

Luminosity of a Coal Gas Flame.—Prof. V. B. Lewes, after a long series of experiments, has come to the conclusion that the formation and decomposition of the hydrocarbon acetylene is the main cause of luminosity in a coal gas flame.

TRADE: PRESENT AND FUTURE.

*** *Correspondence from Trade and Industrial Centres, and News from Factories, must reach the Editor not later than Tuesday morning.*

Oil Trade.—In palm-oil the Liverpool market is rather quiet—Lagos at £21 15s. transit, and Benin £20 5s. ex-quay. Paraffin is in limited demand—American at 5¼d. to 6½d., and Russian 4⅜d. to 4½d., per gallon. Rosin quiet but steady at 4s. 1½d. to 4s. 3d. per cwt. for common ex-quay.

Cotton Trade.—In Manchester and district, the cotton trade remains in an unsatisfactory condition. Some mills in the Pendlebury district have been closed, owing to the miners' "holiday." In Liverpool, from the large crop of cotton this year, the price has already fallen to the lowest it has ever been, but there is now a rising tendency.

Silver Trades.—Here, in Sheffield, there is, speaking generally, a condition of stagnation in the silver and allied trades; some few houses who trade with Australia are, however, better employed than their neighbours.

Hardware Trades.—In Manchester and district trade still continues in the same depressed state. The locomotive-engine builders are very slack, and this causes, to some extent, a corresponding dulness amongst machine-tool makers. Most of the latter are working with a reduced number of hands—some, indeed, with only about half their usual staff. There are very few contracts on hand, with an almost complete absence of new ones, except one or two small orders for abroad. The coal crisis has not, as yet, caused any disturbance in the district iron trade, so there is nothing fresh to chronicle. Very little business is being done, and the outlook is anything but cheerful. Prices remain about the same, and an advance in the price of fuel would probably cause many makers to close their works for a time. The same may be said of the finished iron makers. In Sheffield, Bessemer steel billets of special carbons are quoted at 117s. 6d. per ton, and hematites delivered in the district at from 57s. 6d. upwards. Business is improving in agricultural implements, especially spades and forks. The firms who do business with Spain and Portugal have been busier than they have been for years, owing to the new and higher tariff coming into operation on the 30th June next, and, in consequence, goods are being sent into these countries in immense quantities; but in the meantime great efforts are being made to escape a duty which threatens to make itself severely felt. Very little is now doing in shipbuilders' tools, this branch being less active than formerly.

Cycle Trade.—The few days of fine weather have given a great impetus to the cycle trade in and around Glasgow. Private buyers are on the look-out for a suitable mount for the season, which may be said to have fairly opened, the hiring dépôts being overwhelmed with business. The racing fraternity are also going in for their new mounts, and long since many of them have placed their orders with agents for the very best "racers" that money can procure, some going in for three or four different makes, all of high repute. In Leicester, orders are flowing in in a very gratifying manner. The Leicester Cycle Co. is a young concern, established in 1890. It has grown apace, and the company is now employing some 300 workmen, and the output of cycles has reached something like 270 per week. There is a cycle factory in the North which may be said to locate neither in Scotland nor England, being in that historical border town, Berwick-on-Tweed. Messrs. Denery have here a thriving concern, and have large orders on their books for their cycles, which are in great demand in Scotland and elsewhere, being remarkable for their moderate price when their quality is considered.

Timber Trade.—In London, the pine and spruce trade is very quiet, and, for the matter of that, so is the Baltic trade, as, on account of the absence of trade, merchants are only buying what they require for immediate disposal. 3 by 9 yellow deals command good prices, and as there is not likely to be any fresh stuff in yet, it is likely to continue. Floorings and matchlinings are not commanding such high figures, as the demand is slow and the supply is fairly large. The dock deliveries show a better return, the figures being as follows: Deals and battens, 3,266 stds.; prepared boards, 1,097 stds.; showing an increase of about 200 stds. over the previous report.

Engineering Trade.—There is no improvement to report in the condition of the engineering and iron trades of the Lancashire district, and, with the exception of a few firms who have specialities in hand, there is a general absence of new orders of any magnitude. Locomotive builders continue quiet, and from one of the principal works near Manchester a large number of men have been discharged. Trade in the neighbourhood of Liverpool is decidedly bad, but in the Barrow district engineers and shipbuilders are busy, and although no new orders of any weight have been booked, there is a fair number of inquiries. The unsatisfactory condition of the trade generally is emphasised by the monthly report of the Amalgamated Society of Engineers, which shows that slightly over 8 per cent. of the total membership is in receipt of out-of-work donations. As was to be expected, the iron trade is characterised by a general want of confidence owing to the action of the miners, and although the resumption of work at the collieries has had a somewhat reassuring effect, the general condition of the trade is decidedly bad, and it is considered that both lower wages and cheaper fuel are necessary before any marked revival can take place. In the Newcastle district, orders have been placed with a shipbuilding and engineering firm on the Tyne, and the keel laid down of the first of four very large cargo steamers for the North Atlantic trade. The steamers are for the cattle and copper trades across the Atlantic. Their length between perpendiculars is to be 420 ft., breadth of beam 42 ft., with a carrying capacity of 5,600 tons register. They are to be propelled by twin quadruple expansion engines of 5,000 indicated horse-power collectively, and lighted throughout by electricity.

Building Trade.—In Aberdeen, masons are busiest, most in demand, and scarcest. Their pay is 7½d. per hour, while one employer has offered 8d. per hour. Painters and decorators are not yet very busy, but a great deal of work lies waiting until the weather becomes more favourable; and this promises not to be long. In Manchester, the weather has opened up, and work has started in good earnest. The jerry-builders are very busy, covering acres of ground with cottages in those districts which were amalgamated with Manchester in November of 1890. It would be interesting to know how many plans were rushed through, at the eleventh hour, by speculators. The new Building Bye-laws of the city, with their 14 in. external and 9 in. party walls, and proportionate thicknesses of timbers, are a veritable bugbear to the jerry-builders of cottage property; with the greatest scheming they find the cost of building has been raised 20 per cent. In Bristol and neighbourhood, building is being carried on rapidly in every direction, as contractors state that, after June 1st, masons' and bricklayers' wages are to be advanced. For buildings to be erected after this date, builders now want a considerably higher price in contracts. Considering the amount of buildings now under construction, and the probable estimate, labour, with its present prospects, should be plentiful during the present year.

SHOP:

A Corner for Those who Want to Talk It.

I.—Letters from Correspondents.

Tailoring.—J. H. B. (*Pendleton*) writes:—"May we have some papers on 'Tailoring' after the style of the 'Boot-making' ones, showing how to cut a suit of clothes to measure? I feel sure it would be a boon to many."—[As soon as a thoroughly competent cutter and writer presents himself, "Tailors' Cutting" shall have its turn in Work.—Ed.]

Walking-Sticks.—Richmond Va writes:—"I have a great fancy for collecting walking-sticks, and am most successful in turning them out. As some queries appeared some time ago in Work, I give my experience. The stick must, above all, be well-seasoned. It should be sand-papered according to fancy, care being taken to retain the bark if required. Apply as many coats of shellac varnish as will give a good depth of varnish, say four; the handle may require more if rough like a bit of root. Rub this down with pumice-powder and water. If the varnish appear thin in places, stop for the present, and put on more. When the stick has been well rubbed down, use a little dry pumice-stone powder to bring out the gloss, and if this is not sufficient, pour a little spirits of wine on a soft rag, and rub the stick lightly over with it. Care must be taken that the rag does not stick; a little manipulation is required.'

Fretwork Patterns.—Omadaun writes:—"Yet another 'tip' regarding fretwork patterns. A great percentage of these consists of either a repetition of the same design—as, for instance, a border in which a certain part repeats until a requisite

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length is obtained—or of a pattern in which one-half is the exact reverse of the other. Now, I take it that an exact pattern is the first essential to exact workmanship, and to trace a pattern that shall be perfect and an exact repetition is not always easy: this being especially the case if an enlargement is being made. My 'tip,' then, is simply to make use of the copying-press. If the pattern, or so much of it as repeats, is traced in copying ink, several duplicates can be obtained, which are, of course, exact repetitions of the pattern. Again: as the press copies are equally clear on either side of the paper, it is evident that an exact reversal of a pattern can also be obtained; so that if, for instance, an ornamental vase is required, it is only necessary to take off two press copies, divide them equally in the centre, and use the same half from *each* pattern—one, of course, being reversed; and the result is a perfectly true design so far as both sides being alike is concerned. I have found this to be a useful 'tip,' and it has a further advantage also of leaving the original pattern for future use; and the thin tissue paper used for the copies is also convenient."

Patent.—S.E. (*Upper Clapton*) writes, in sequence to C. E. (*London, N.W.*) (see No. 152, page 763):—"I should be inclined to let the sarcastic remarks of C. E. remain unnoticed were it not for the stubborn fact that he *is* wrong, and that his erroneous advice may lead other of your readers into serious trouble if they allow themselves to be guided by it. Allow me, for this reason, and in fairness to myself (whom C. E. kindly indicates as 'a fool rushing in where angels fear to tread'), to point out and prove his error. On page 492, No. 135, C. E. states: 'This provisional protection lasts nine months from the date of application, and before the expiry of this term the complete specification, claims, and drawings must be filed, or the patent is lost. If, however, it is found that what has to be done cannot be completed within that time, an extension of time of one, two, or three months may be applied for, for one of the three periods named, with the stamps for fees of £2, £4, or £6 impressed upon the application; but no further extension of time will be granted.' In my reply (No. 141, page 587) I tried to point out in a gentlemanly manner that 'one month, and one month only, beyond the original nine months can be obtained for filing the complete specification, and the stamp duty required on the form is £2.' This statement brings down upon me the scathing reply of C. E. (p. 763, No. 152), in which he refers me to the Patent Office Rules, where I am to find that he is right and I am wrong! Now, Mr. Editor, I have before me the Patents, etc., Acts, 1883 to 1888 (consolidated), and in Part II., Section 8, I find these words: 'A complete specification may be left within such extended time, *not exceeding one month after the said nine months*, as the Comptroller may, on payment of the prescribed fee, allow. *Unless a complete specification is left within that time, the application shall be deemed to be abandoned.*' And in the Patent Rules I find, in the list of fees, 'For enlargement of time for filing complete specification, *not exceeding one month*, £2.' Now, Sir, having given C. E. incontestable proof that my original statement was correct, I call upon him to be 'plucky enough' to acknowledge his error."

Connecting Link.—BAPTISTA writes:—"With regard to the connecting link for chains mentioned in WORK (No. 152, page 759), I beg to say that links similar to the one described are for sale in the ship chandlers' stores. I say similar, for they are not exactly alike, being sold in two or three different shapes. One link, I remember, is in two halves, connected by a pivot, the arrangement for introducing the links of the chains to be connected being particularly ingenious, though rather difficult to describe on paper. I am sure if the writer pays a visit to some ship chandler's or ironmonger's, he will see links rivalling in ingenuity the excellent one which he describes."

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Brass Ferrules.—RESILIENT (*Hoxton*).—Are these required for fishing-rods or similar purposes? If so, you might try G. Curvell, Jewry Street, Winchester.—M. M.

Model Boiler.—G. S. (*Fulham, S.W.*).—About 14 or 15 B.W.G. will be amply stout enough if you have it of solid drawn tube, which I strongly advise in preference to riveting or brazing. If you are going to rivet, better have it one or two gauges thicker. You can get the copper of Stanton, Shoe Lane, E.C. Price for a small quantity, about 1s. 4d. per lb.—J.

Model Ship.—J. H. (*Leeds*).—From your very indefinite question, I have come to the conclusion that it is not a model ship only, capable of working in rough water, that you want, but a model sea as well, the mechanism for driving the vessel being outside it. And I also suppose that you want the mechanism enclosed in a box, and the ship to sail round in a circle, at the same time rising and falling as if at sea; at least, as near as one can approach to it. If I am right in my conjecture, the four sketches (Figs. 1, 2, 3, and 4) will explain a system which you can modify to suit yourself. Fig. 1 is a sectional elevation, and Fig. 2 a plan; Figs. 3 and 4 are enlarged views of the vessel and lines. The size of everything will have to be made to suit the size of the boat (which, however, must not be large if driven by clockwork), so you must decide that first. Having obtained a vessel (A) of a suitable size, fasten two supports (*a*, *a*) at each end, connecting them by a stiffening piece (*b*), with a narrow vertical slot (*c*) in it of such a length that the finger (*d*, Figs. 1, 3, and 4), though keeping at the same vertical height, may continually push the boat round in a circle, though the latter keeps rising and falling. The sea would be best represented by an evenly corrugated circular piece of sheet-iron (B) painted to represent the sea. Various kinds of waves could be made. The corrugations should be made suitable to the size of the boat, but they should not be too deep, or the power necessary to drive the boat could not be obtained from a clock works. A circular disc can now be cut out so that a slot (C) is left through which the boat supports pass. The central portion must be carried on turned pillar (*e*) rigidly fixed into support (*f*) fastened to the bottom of the box. The exterior portion can be fastened to the wood of the box. Below the slot (C) a brass channel rail (*i*) should run all the way round, every point in its circumference being equidistant from and exactly underneath the surface of the sea at the slot. This rail (*i*) is so constructed that by means of two broad wheels (*j*), with central projections on the rim to fit the channel rail, the boat is kept perfectly steady. The end of the finger (*d*) should pass through the slot (*c*) with a washer fixed on either side, just allowing the end of *d* to pass easily up and down the slot, but with as little shake as possible. The finger (*d*) must be fixed to the top of the sleeve (*g*) of spur wheel (*h*), the sleeve and wheel being drilled to fit pillar (*e*) and turn round on it. The wheel (*h*) can be placed in any suitable position as regards height on the sleeve (*g*), so that it will gear with the last of the train of clockwork wheels. You must arrange the works of clock to suit the power required, taking out some of the quick-running weak wheels, so that you will obtain the necessary power to drive the boat, which should be as light as possible. I hope these few remarks will be sufficient to help you on your way, as I cannot lengthen them out in "Shop" columns, the space is so crowded at present.—P. B. H.

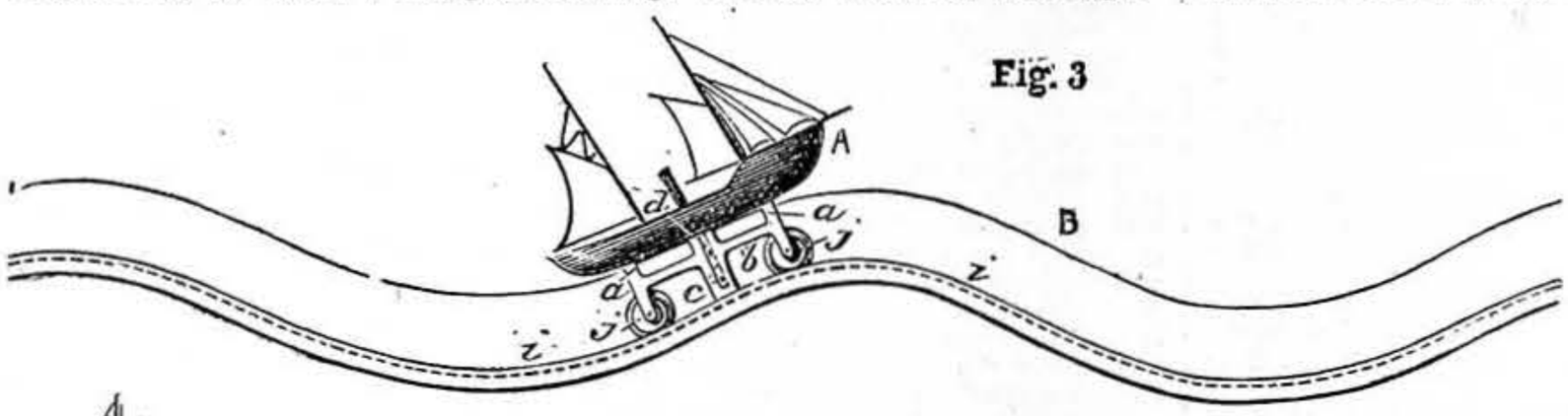

Fig. 3

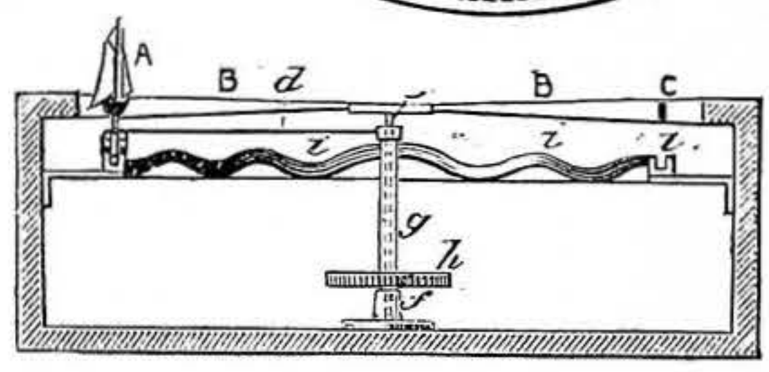

Fig. 1.

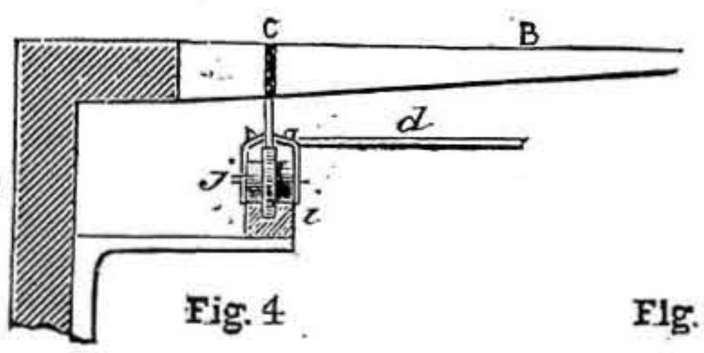

Fig. 4

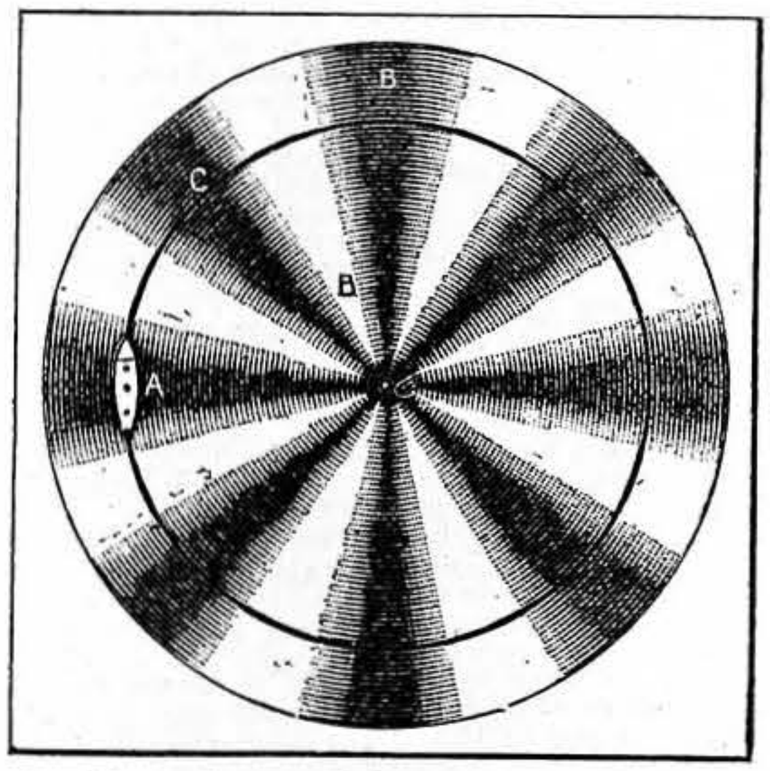

Fig. 2

Model Ship. Fig. 1.—Sectional Elevation. Fig. 2.—Plan. Fig. 3.—Enlarged View of Vessel, Rail, etc. Fig. 4.—Cross Section of Rail.

Gloss.—IRIS.—The special and particular gloss upon any class of fancy goods may be obtained by methods quite beyond the amateur's conditions of work. A polish must either be brushed on or "rubbered" on, unless the article is of a nature suited to japanning and stoving. If you require a black varnish or polish for cabinet work (trade quantities), write either H. Kershaw, Newington Causeway, S.E., or C. W. Waters, Great Eastern Street. If yours is merely a fancy novelty, you can get nothing more suitable than a small pot of a good maker's black enamel. These things cannot be satisfactorily made by novices from recipes.—F. P.

Smoking Chimney and Damp Walls.—SLIEVENAMAN.—Doubtless the opening between the two flues would have a bad effect on the draught, and it would be well to try the effect of stopping it before proceeding to further alterations. Your damp wall, I presume, has a rainy exposure—to south or south-west, perhaps. Cement painted, and the paint renewed every third year, would, no doubt, keep it dry; but if your walls are not too high, and the situation one in which you can grow ivy, why not try that natural remedy? It is cheapest, and looks best. The leaves overlap each other, and throw off the rain like weather-slates. By planting it I have made the one damp corner of my own house perfectly dry, and have now bookshelves in it. Put in well-established plants—such as have had four or five years' separate growth—cutting them down to within 20 in. of the ground, and they will soon cover any required space. Your ivy must, of course, be kept trimmed away from spouts, which it is apt to fill, and from roofs, on which it displaces the tiles.—M. M.

Secret Dovetailing.—G. F. B. (*Victoria Barracks*).—The article treating of this subject appeared in No. 129 of WORK.

Telegraph Posts.—K. M. D. (*Harling*).—In ordinary building operations, a coating of red-lead paint answers for preserving wood that is fixed in "mother earth." Two methods are open to use: one, soaking in oil, or of a similar nature, such as will penetrate the wood, and then, when dry, encase the particles with a film; or a body mixture of paint or tar, which, by the nature and thickness of the coatings, seals up the wood from atmosphere and moisture. I do not know of any special mixture in use for above purpose. Oil pigment mixed with petroleum is also a good and cheap paint.—F. P.

Accumulators.—J. H. L. (*Kensington*).—Illustrated instructions on making accumulator cells were given in No. 101, p. 790, Vol. II. of WORK. If you require a current of 4 ampères for a period of four hours, at a pressure of 25 volts, you must have thirteen cells, each cell furnished with lead plates exposing a surface area of three square feet to the action of the acid. The surface area may be obtained by employing several small plates, or by means of three large plates in each cell. As the pressure of the current from each cell equals 2 volts, you may obtain any multiple of 2 up to 26 by connecting the cells in series; thus, two cells will give a current of 4 volts, three cells a current of 6 volts pressure, and so on. Twelve of the cells may be charged in series at once by the current from your dynamo, if the commutator of the machine is suitable to the purpose of charging accumulators—that is, if it has more than two parts.—G. E. B.

Electrical Terms.—R. S. (*Felixstowe*).—The terms volt, ampère, watt, and ohm, used in writings on electric lighting subjects, are names given to measurements of electric currents and conductors for the same. The volt is a unit of electric current pressure, equal to that obtained from one Daniell cell. The ohm is a unit of resistance measurement in an electric current conductor, and equals nearly that of 6 ft. of No. 36 pure copper wire. The ampère is the unit of electric current volume, equalling that obtained from a current of one volt through a resistance of one ohm. The watt is a unit representing the combined volume and pressure of the current, as per example: 2 ampères × 8 volts = 16 watts.—G. E. B.

Safety Bicycle.—X. Y. (*Princes Risboro'*).—The articles on the "Safety Bicycle" appeared in WORK, Nos. 107, 111, 115, 119, 124, 127, 132, 137, 142.

Breeding Cage.—J. P. (*Liverpool*).—An article on "A Breeding Cage for Canaries" appeared in WORK, No. 108.

Bookbinding.—A NOVICE.—The articles on "Bookbinding" appeared in Nos. 6, 9, 57, 61, 65, 69, 72, 75, 80, and 85 of WORK.

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Couch Bedstead.—H. S. S. (*Monkwearmouth*). This appeared in WORK, No. 130.

Picture-Frame Making.—NO NAME.—Articles appeared in WORK, Nos. 106 and 109.

III.—QUESTIONS SUBMITTED TO READERS.

**** *The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Musical Glasses.—J. R. S. (*Liverpool*) asks for the proper solution with which to wet the fingers to induce music from twenty-eight glasses he has got together.—[Doubtless, some obliging reader will help J. R. S. In the meanwhile, should our friend be visiting London, he should seek out Paternoster Row between one and two o'clock in the day. There he will be pretty certain to discover a genius of romantic mould, who, with the aid of a puddle of water and a few glasses, has been successfully contributing to the glories of the London street music, to our knowledge, for the past twenty years.—ED.]

Puzzle Tobacco Box.—J. T. (*Sunderland*) writes:—"Will some reader kindly give me a sketch of puzzle brass tobacco box?"

C. T. Monogram.—M. (*Prince's Park*) writes:—"Will some reader please give me a design for monogram, C.T., to carve in oak for panel?"

Wind-Power Grindstone.—P. T. (*Birmingham*) writes:—"I should feel thankful if some of my fellow-readers of WORK would kindly give me a sketch of a windmill of a sufficient size to turn a grindstone, say, 3 ft. in diameter; informing me also if the fans can be made to regulate according to the power of the wind."

Ebonising Fretwork.—UTILE DULCI writes:—"Would any obliging reader acquaint me with the best methods and the materials necessary, adding probable cost, for, first, ebonising fretwork cut out of, say, common woods usually employed for this purpose; and secondly, for gilding fretwork made of the same material, a liquid for the latter being preferred?"

Electric Locomotive Engine.—J. J. (*Blackpool*) writes:—"I have a small model locomotive engine which will work by steam. Can I make it to work with electricity? If so, will any reader of WORK please state how, and where I can obtain the necessary materials?"

Lathe.—RICHMOND VA writes:—"Can anyone recommend me a publication giving directions shortly and concisely as to turning metal in a lathe? I have a lathe with all tools complete, but no one to show me their use."

French Polishing.—RICHMOND VA writes:—"As an amateur, I have never succeeded with French polishing, so have looked all round for a substitute, which I think I have found. Will someone who has tried it give me their experience? Here, in the U.S.A., the manufacture and polishing of furniture is carried to much perfection. So far as Richmond is concerned, French polishing is scarcely known, being too troublesome; they go in for quick methods here. Several coats of hard oil finish (or shellac varnish, which is said to do as well) are laid on the piece to be polished, the surface, when dry, to be rubbed down smooth with powdered pumice-stone and water. When a sufficient depth is obtained, a final coat of varnish is laid on; and to produce a glassy surface on this, rotten-stone is applied with a damp woollen rag, and the dry palm of the hand rubbed over it produces a surface which French polish will not beat. I have seen the rotten-stone applied, and can testify to the beautiful surface it gives to the rough varnish. I am told that this process is quite as durable as French polish."

Chip Carving.—PETERBORO' writes:—"Will any reader please give me information on chip carving?"

Syrups.—W. W. (*Glasgow*) writes:—"I would thank any correspondent if he would tell me the name, price, and publisher of any books on the making of syrup for aërated waters on a large scale."

Skin Preparing.—R. R. (*Harrow Road*) would ask a brother subscriber to tell him how to dress hare and rabbit skins so as to get a chamois-leather body with the fur on; and what materials to use with that result.

Sugar Soap, Brushes, etc.—S. J. G. (*London, W.C.*) writes:—"Will some correspondent kindly inform me what are the ingredients of 'sugar soap,' such as painters use for cleaning paint and varnish work, and the proper strength to use it? Also the best way to keep paint and varnish brushes from getting hard and unfit for use after use."

Frame-making Trade.—SENTINEL writes:—"Can any practical hand say or advise which is the most useful and thorough mitre-cutting machine in the trade—say, the one by the Britannia Co., or Booth Bros., or any other? Also, where could I obtain mount-cutting tools, etc?"

Monogram.—TINSMITH writes:—"Will anyone kindly give me a monogram for R. F. for fretwork?"

Fat, To Purify.—L. H. (*Everton*) will thank a correspondent to tell him how to clean dripping and other fats for edible purposes.

Miners' Drills.—LANARKSHIRE writes:—"I shall be obliged if any reader would give me a description for making a hand machine for twisting miners' drills from 1 ft. 4 in. to 4 ft. 6 in. in length, the steel to be twisted being 1¼ in. and ⅜ in."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Besom Makers.—W. G. (*Ruabon*) writes, in reply to L. S. D. (*No Address*) (see No. 144, page 635), that Mr. Thomas Jackson, of Tai Nant, near Ruabon, manufactures heath and birch besoms.

Candle Making.—J. H. W. (*New Brompton*) writes, in answer to J. W. W. (*Renshaw*) (see No. 153, page 782):—"I have had a long practical experience in candle making. Have you a steam boiler workable up to 20 lbs. per square inch? Whatever process you may choose to adopt, steam is one of the most necessary things."

Venetian Blind Laths.—HALL writes, in reply to H. H. (*Chacewater*) (see No. 151, page 750):—"You can get laths in this city (Birmingham) from A. Shepherd, 58, Ludgate Hill; Blind Co., 192A, Coventry Road; H. Edwards, 9, Stafford Street."

Tailors' Cutting and Fitting.—Messrs. Simpson and Johnston (*Llanbryde*) and C. K. (109, *Wellington Street, Gorton*) desire G. R. D. (*Cheetham*) (see No. 151, page 733) to place himself in communication with them.

Old Paper.—J. H. B. (*Pendleton*) writes, in reply to J. W. (*Plumstead*) (see No. 148, page 702):—"Mr. Chas. Hatton, Gaythorn Paper Mills, Manchester, purchases old paper, etc. He would send J. W. his terms on application."

Wood.—M. (*Bishop Auckland*) writes to J. B. (*Birmingham*) (see No. 153, page 782):—"Try J. Parker, Highgate Street and Conybere Street; W. D. Rudder & Son, Chester Street and Hubert Street; or J. Ball, Midland Saw Mills, Penn Street—all in Birmingham."

Marble Stains.—J. L. (*Upper Holloway*) writes to SCULPTOR (see No. 152, page 764):—"If SCULPTOR will get some salts of wormwood, and dissolve in warm water, then mix with whiting into a moderate paste, and apply to stone or marble, and let it remain upon either for twenty-four hours—and if not successful the first time, apply again—he will draw all stains out of marble, and clear all lichen either from sandstones or oolitic stones. Thoroughly wash the stone with a strong soap (say, of Hudson's No. 2 soap powder) and lukewarm water, and, when thoroughly dry, give a coat of sulphuretted oil. He can make his own oil. Boil in a bath one quart of linseed oil for one hour, with ½ lb. of flower of sulphur, gently and continually stirring same; then take off fire, and let cool; then pour oil from sediment, using oil upon stone. No lichen will hurt his stone if out exposed to the air, for the rain will wash all clean every time. I have cleaned several statues with nothing but Hudson's No. 2 and water."

Blowing Fan.—K. H. (*Blackburn*) writes:—"I take it that WAREHOUSEMAN (see No. 151, page 750) has power in his warehouse. He should write to the 'Blackman Air Propeller Company, Limited,' 63, Fore Street, London, E.C., giving them the length, breadth, and height of the place he wishes to ventilate. They will then send him full particulars as to how the ventilation should be carried out."

Galvanised Iron.—K. H. (*Blackburn*) writes:—"The following is taken from Molesworth's 'Engineering Formulæ,' and may suit COLONIST (see No. 151, page 750). (1) Pickle the article six or eight hours in water containing about 1 per cent. of sulphuric acid held in wooden vessels. The acid requires to be renewed from time to time, according to the quantity of iron pickled. (2) After pickling, scour and wash well in clean water. (3) Keep the article under clean water (in which a little fresh burnt lime has been stirred) until ready for the next process. (4) Immerse in chloride of zinc for one or two minutes, until a skin of fine bubbles is formed on the surface. (5) Dry the article on a heated iron plate, then immerse it in a bath of molten (not glowing) zinc until it acquires the temperature of the zinc bath. The surface of the molten zinc should be protected by sal-ammoniac or some other substance. In some cases there is a partition at the surface of the bath, one portion of the surface being protected with sal-ammoniac, the other with a layer of charcoal. (6) Beat the article while hot, to remove the excess of zinc."

Utilising Coal-dust.—W. J. B. (*Deptford*) writes to HOUSEHOLDER (see No. 151, page 750):—"A cheap fuel may be made by mixing two parts coal-dust, two parts saw-dust, four parts sand, and one of clay with water. Mould into lumps, and set aside to dry. These will not light a fire, but can be used in conjunction with a little coal to maintain heat."

Telegraph Instrument.—M. (*Bishop Auckland*) writes to TELEGRAPHIST (see No. 155, page 814):—"You will require a small magnet, about ½ in. by 1/16 in., and of suitable length, fixed on a steel axle, and made to swing on pivots. One end of the axle projects through the dial, and has a needle fixed by one end to it, and with a pin at each side to prevent it swinging too far; two coils of silk-covered copper wire on brass or paper bobbins are fixed inside, and the magnet swings inside the coils. The wire from the coils is connected at one end, and the other ends are brought through two keys, or a handle fixed on an axle, which is contrived to reverse the current by pressing either key, or by moving the handle to right or left. A Leclanché battery will work it."

"Great Eastern."—REV. J. P. (*Durrus*) writes, in answer to MODEL S. L. (see No. 155, page 814):—"The dimensions of the *Great Eastern* were: Length, 692 ft.; beam, 83 ft.; depth, 59 ft.; six masts; 25,000 tons burden; draught of water when laden, 30 ft.; screw and paddle; four decks; spread 6,500 square yards of canvas. The above particulars are taken from a medal struck when the great ship was built. There is a representation of the vessel on the medal."

Glass Blowers.—C. G. M. (*Penistone*) writes, in answer to DROSFABA (see No. 156, page 830):—"Townson & Mercer, Bishopsgate Street Within, keep all kinds and sizes of glass and tubing. They also make chemical and scientific glass-ware of all sorts."

Engine for Lathe.—D. (*Holyrood*) writes, in reply to LATHE (see No. 150, page 733):—"I should advise him to write to Crossley Bros., Manchester, or to Andrews & Co., Stockport. They both make an engine for small powers, vertical stroke, which occupies very little floor space, and turn out first-class work that can be depended on."

Antique Furniture Designs.—M. (*Bishop Auckland*) writes to H. R. (*Kidderminster*) (see No. 153, page 782):—"One of the following books may suit you. 'Antique Furniture,' price 36s.; 'Furniture of the Sixteenth, Seventeenth, and Eighteenth Centuries,' by Pequenotz, price 36s.; 'Specimens of Ancient Furniture,' by H. Shaw, 25s.; 'Examples of Ancient and Modern Furniture,' by B. J. Talbert, price 28s.; from Batsford, High Holborn."

"Great Eastern" Model.—W. M. (*Stechford*) writes to MODEL S. L. (see page 814, No. 155):—"I have a large model of the *Great Eastern* in glass case complete that I want to sell. If your correspondent hands over two guineas to the National Lifeboat Institution, he can have it. The glass, mahogany case about 3 ft. 6 in. long, 1 ft. 8 in. high, and 14 in. deep, with sea view painted as background, without the vessel, is worth at least 30s., so he can have a bargain, and secure the lifeboat at the same time. Cardboard men, 2,000 on deck and in rigging, show half the number she can carry; the remaining 2,000 are supposed to be below."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—AN APPRENTICE CARPENTER; J. H. (*Stratford*); T. B. B., JUNR. (*Manchester*); W. J. (*Laurencekirk*); VULCAN; J. H. (*Oldham*); J. B. (*Burton-on-Trent*); A. B. (*Westminster*); W. L. (*Basford*); PHOTOGRAPHIC SOCIETY (*India*); BRUSH; LEARNER; S. C. (*Ashton-under-Lyne*); H. S. (*Birkenhead*); G. W. W. (*Shields*); H. A. A. (*Bristol*); READER; R. G. (*Grantham*); W. R. H. (*Lincoln*); P. M. (*Wigan*); A. B. L. (*Nottingham*); MEXICO; J. S. (*Sheffield*); A. E. A. (*Ipswich*); CELLULOID BARLEY; J. H. H. (*Robert Town*); BARRA; T. R. (*No Address*); J. A. (*Bow*); CLOCK; W. M. (*Portland*); EDDIFRA; SEVERAL DAILY READERS; SOCRATES; A. D. (*Sheffield*); W. H. (*Rotherhithe*); R. A. R. B. (*Oxford*); G. R. (*Manchester*); J. H. S. (*Basingstoke*); C. H. W. (*Seacombe*); R. D. T. (*Marylebone*); G. P. W. (*Ulceby*); H. B. S. (*Liverpool*); E. R. A. (*Devonport*); C. M. (*Norwich*); J. A. M. (*Rathfriland*); C. L. (*Chew Magna*); H. L. (*Lancaster*); H. L. H. (*West Hampstead*); S. V. (*No Address*); J. J. (*Bromley*); F. P. (*Wellington*); E. C. S. (*Stoke Bishop*); L. G. (*Dorking*); F. S. L. (*Liverpool*); G. H. H. (*Leeds*); F. F. (*Erith*); L. F. (*Liverpool*); W. H. (*Londonderry*); W. T. (*Houghton-le-Spring*); C. G. M. (*Penistone*); A. M. B. (*Dublin*); REV. J. P. (*Durrus*).

SALE AND EXCHANGE.

Victor Cycle Co., Grimsby, sell Mail-cart Wheels and Parts. [24 R

Lettering and Sign-Writing made Easy.—Also full-size diagrams for marking out eight alphabets, only 1s.—F. COULTHARD, Darlington Street, Bath. 100 Decorators' Stencils (60 large sheets), 2s. 6d.

Fret, Carving, and Repoussé Patterns.—100 of either, full-size, 1s.; 35 Fret Photo Frames, 1s.; 30 Fret Brackets, 1s.; 100 Sign-writer's Stencils, 1s.; 300 Turning Designs, 1s.; 400 small Stencils, 1s.; 500 Shields, Monograms, &c., 1s., postage free.—F. COULTHARD, Darlington Street, Bath (late Bournemouth). [2 S

Cycle Fittings, mail-cart wheels and shafts, mitre-cutting machines and cramps.—WALKER BROS., Wellington Road, Leeds. [22 R

Fretwork Designs.—25 small, 4d.; six large Brackets. 1s. 1d.; six grand Photo Frames, 1s. 1d.; Catalogue of 300 Miniatures, 6d. Lists free.—TAYLOR'S Fretworkeries, Blackpool. [25 R

Moor's Blowpipe, as noticed in WORK, No. 155, 2s. 9d., post free.—MOOR, 23, Hill's Road, Cambridge. [27 R

Wanted.—Agents everywhere to solicit orders for Hendy's Patent Brush Handle. Write for particulars.—JOHN HENDY, 21, Brougham Street, Bolton. [1 S

Water Motors, from 5s. each; ⅛ h.-p., 20s.; list, one stamp.—WALTON, 9, Queen Anne St., Stoke-on-Trent. [4 S

Buyers of Gas or Steam Engines, Machinery, and Tools, should call at Britannia Co., 100, Houndsditch, London, or send 2d. for the Tool and Machinery Register, containing 4,000 lots wanted and for sale. Address—REGISTER, Britannia Co., Colchester. [29R

Injectors, simple and reliable; a boy can use them; 21s., 30s., 40s. Liberal trade discount.—POWELL, Engineer, Tunbridge Wells. [5 S

Bird-stuffing, illustrated, 7d.; egg drills and blowpipe, 1s.; egg-collecting outfit, 2s. Illustrated catalogue, naturalists' requisites, entomological apparatus, artificial eyes, 2d.—Messrs. DAVIS, Taxidermists, Dartford. [6 S

For Sale.—Self-acting Fountain for Garden. Will work 5 hours. New, 20s. Particulars—A. JOHNSTON, Clothier, Lhanbryde, N.B. [3S

WORK, Vols. I., II., III.—Quite perfect. Vol. I. is bound. What offers in cash?—X. Y., c/o Cutbush, High Street, Highgate, London.

Wanted.—Back numbers of WORK, from the commencement. What offers? Must be cheap. Apply—WILLIAM GRIFFITH, 9, Philip Terrace, Tottenham, N.

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